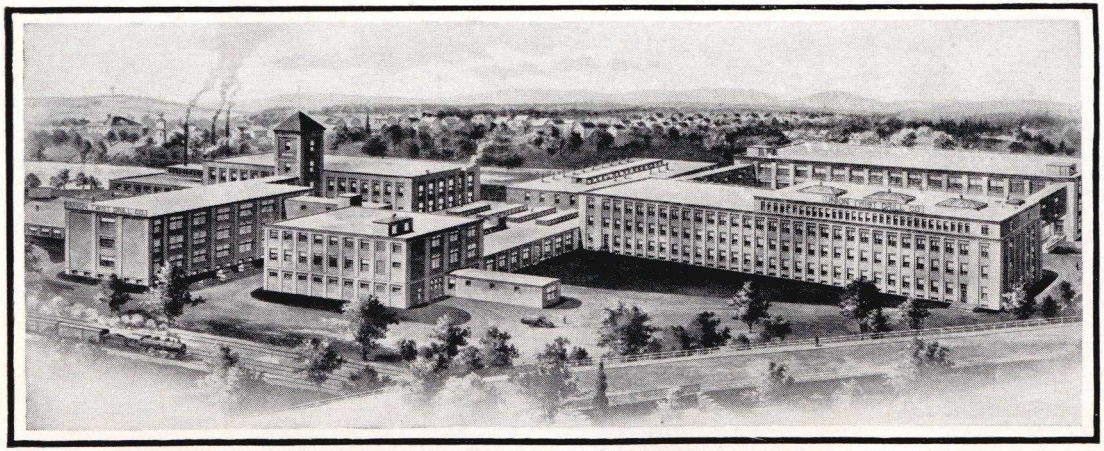
UNION TWIST DRILL CO.

ATHOL · MASS · U·S·A·

F. G., M. HURST



UNION TWIST DRILL COMPANY

Athol, Massachusetts, U. S. A.

SEVEN ACRES OF FLOOR SPACE

UNION TWIST DRILL COMPANY

ATHOL, MASSACHUSETTS, U. S. A.

MANUFACTURERS OF

MILLING CUTTERS
GEAR CUTTERS
TWIST DRILLS
HOBS & REAMERS
MACHINE TOOLS

CATALOG N

JANUARY, 1939

REPRINT JANUARY, 1942

CABLE ADDRESS, UNDRILL ATHOL
CODES, LIEBERS, WESTERN UNION

STORES WITH COMPLETE STOCKS

NEW YORK.....61 Reade Street
CHICAGO.....11 South Clinton Street
DETROIT.....6540 Antoine Street
SAN FRANCISCO.....121 Second Street
LOS ANGELES.....524 East Fourth Street
SEATTLE.....568 First Ave. South

WE OWN AND OPERATE

S. W. CARD MFG. CO., DIVISION

MANSFIELD, MASSACHUSETTS

BUTTERFIELD DIVISIONS

DERBY LINE, VERMONT — ROCK ISLAND, QUEBEC

Manufacturers of Taps, Dies and Screw Plates

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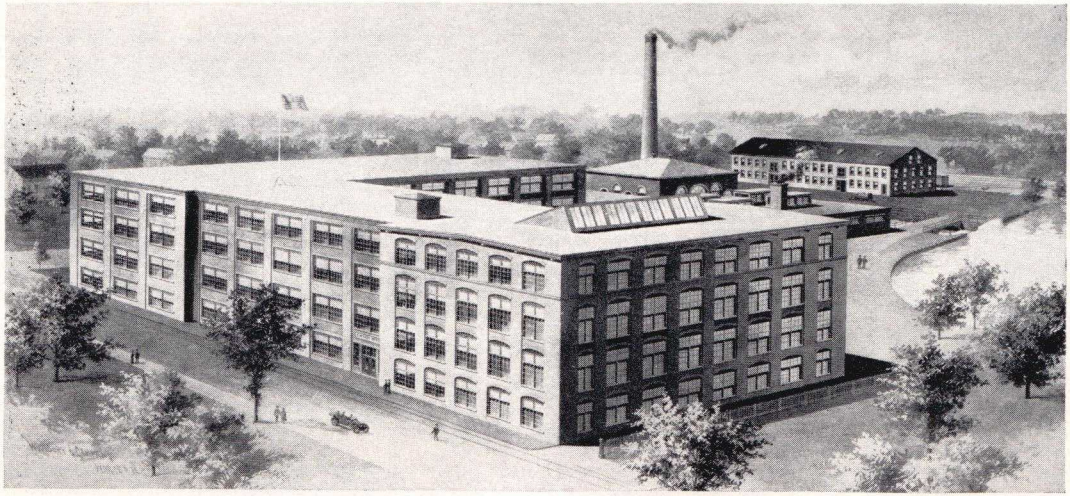
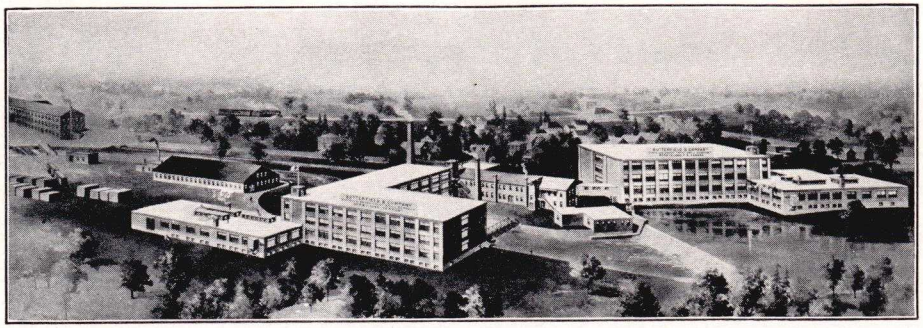


S. W. CARD MFG. CO. DIVISION

Mansfield, Massachusetts

TWO ACRES OF FLOOR SPACE

Manufacturers of Taps, Dies, Screw Plates, Die Stocks and Tap Wrenches



BUTTERFIELD DIVISIONS

TWO AND A HALF ACRES OF FLOOR SPACE

Derby Line, Vermont : Rock Island, Quebec

United States Factory, Derby Line, Vermont. Manufacturers of Taps, Dies, Screw Plates, Blacksmith's and Die Stocks and Dies, Tap Wrenches and Reamers.

Canadian Factory, Rock Island, Quebec. Manufacturers of Twist Drills, Reamers, Milling Cutters, Hobs, Gear Cutters, Taps, Dies, Screw Plates, Blacksmith's and Pipe Stocks and Dies, Tap Wrenches.

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Milling Cutters

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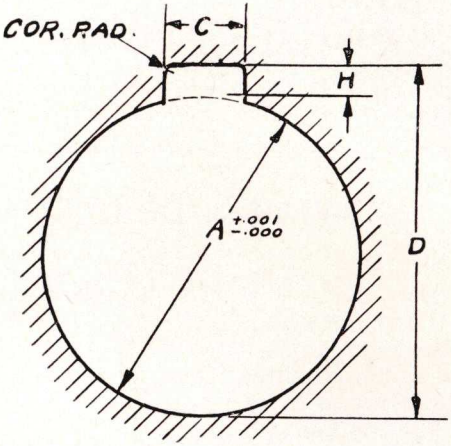
Standard Keyways for Cutters



Bore and Keyway

Cutter Bore "A" Inches	Nominal Size Key (Square) Inches	Dimensions—Inches					
		C		D		H Nominal	Corner Radius
		Maximum	Minimum	Maximum	Minimum		
1/2	3/32	.106	.099	.5678	.5578	3/64	.020
5/8	1/8	.137	.130	.7085	.6985	1/16	1/32
3/4	1/8	.137	.130	.8325	.8225	1/16	1/32
7/8	1/8	.137	.130	.9575	.9475	1/16	1/32
1	1/4	.262	.255	1.1140	1.1040	3/32	3/64
1 1/4	5/16	.325	.318	1.3950	1.3850	1/8	1/16
1 1/2	3/8	.410	.385	1.6760	1.6660	5/32	1/16
1 3/4	7/16	.473	.448	1.9580	1.9480	3/16	1/16
2	1/2	.535	.510	2.2080	2.1980	3/16	1/16
2 1/2	5/8	.660	.635	2.7430	2.7330	7/32	1/16
3	3/4	.785	.760	3.2750	3.2650	1/4	3/32
3 1/2	7/8	.910	.885	3.9000	3.8900	3/8	3/32
4	1	1.035	1.010	4.4000	4.3900	3/8	3/32
4 1/2	1 1/8	1.160	1.135	4.9630	4.9530	7/16	1/8
5	1 1/4	1.285	1.260	5.5250	5.5150	1/2	1/8

For intermediate size bore use the Keyway for the next larger size bore listed.

Cutters that have Keyway other than shown in above table are special.

The Proper Use of Milling Cutters

It is impossible to lay down any fixed rules for the speeds to be used on Milling Cutters because of the countless variations in the conditions under which the work may be done. As a general guide these peripheral speeds may be used:

Carbon Steel Cutters:

In annealed tool steel	20-30	feet per min.
In machinery steel	30-40	feet per min.
In cast iron	40-60	feet per min.
In brass	80-100	feet per min.

High Speed Steel Cutters:

In annealed tool steel	60-80	feet per min.
In machinery steel	80-100	feet per min.
In cast iron	70-100	feet per min.
In brass	150-200	feet per min.

To find revolutions per minute for any diameter of cutter for a given peripheral speed see tables on pages 10 and 11.

Saws should be run at lower speed and feeds than cutters.

It is impossible to make any specific suggestions as to feeds. These must be determined by the nature of the material, the rigidity of the machine and the fixture and the quality of finish desired.

It is of the utmost importance that cutters be properly sharpened. Failure to observe this caution leads to chatter with destructive effect on cutter and machine alike, and results in excessive cutter wear.

The work must always be rigidly supported and firmly clamped, and yielding or vibration in arbor, machine, or work table should be promptly investigated and eliminated.

Table of Cutting Speeds

Ft. per Min.	15	17.5	20	22.5	25	27.5	30	35	40	45	50	55
Diam. In.	REVOLUTIONS PER MINUTE											
1/16	917	1070	1222	1375	1528	1681	1833	2139	2445	2750	3056	3361
1/8	458	535	611	688	764	840	917	1070	1222	1375	1528	1681
3/16	306	357	407	458	509	560	611	713	815	917	1019	1120
1/4	229	267	306	344	382	420	458	535	611	688	764	840
5/16	183	214	244	275	306	336	367	428	489	550	611	672
3/8	153	178	204	229	255	280	306	357	407	458	509	560
7/16	131	153	175	196	218	240	262	306	349	393	437	480
1/2	115	134	153	172	191	210	229	267	306	344	382	420
5/8	91.7	107	122	138	153	168	183	214	244	275	306	336
3/4	76.4	89.1	102	115	127	140	153	178	204	229	255	280
7/8	65.5	76.4	87.3	98.2	109	120	131	153	175	196	218	240
1	57.3	66.8	76.4	85.9	95.5	105	115	134	153	172	191	210
1 1/8	50.9	59.4	67.9	76.4	84.9	93.4	102	119	136	153	170	187
1 1/4	45.8	53.5	61.1	68.8	76.4	84.0	91.7	107	122	138	153	168
1 3/8	41.7	48.6	55.6	62.5	69.5	76.4	83.3	97.2	111	125	139	153
1 1/2	38.2	44.6	50.9	57.3	63.7	70.0	76.4	89.1	102	115	127	140
1 5/8	35.3	41.1	47.0	52.9	58.8	64.6	70.5	82.3	94.0	106	118	129
1 3/4	32.7	38.2	43.7	49.1	54.6	60.0	65.5	76.4	87.3	98.2	109	120
1 7/8	30.6	35.7	40.7	45.8	50.9	56.0	61.1	71.3	81.5	91.7	102	112
2	28.7	33.4	38.2	43.0	47.7	52.5	57.3	66.8	76.4	85.9	95.5	105
2 1/4	25.5	29.7	34.0	38.2	42.4	46.7	50.9	59.4	67.9	76.4	84.9	93.4
2 1/2	22.9	26.7	30.6	34.4	38.2	42.0	45.8	53.5	61.1	68.8	76.4	84.0
2 3/4	20.8	24.3	27.8	31.3	34.7	38.2	41.7	48.6	55.6	62.5	69.5	76.4
3	19.1	22.3	25.5	28.6	31.8	35.0	38.2	44.6	50.9	57.3	63.7	70.0
3 1/4	17.6	20.6	23.5	26.4	29.4	32.3	35.3	41.1	47.0	52.9	58.8	64.6
3 1/2	16.4	19.1	21.8	24.5	27.3	30.0	32.7	38.2	43.7	49.1	54.6	60.0
3 3/4	15.3	17.8	20.4	22.9	25.5	28.0	30.6	35.7	40.7	45.8	50.9	56.0
4	14.3	16.7	19.1	21.5	23.9	26.3	28.7	33.4	38.2	43.0	47.7	52.5
4 1/2	12.7	14.9	17.0	19.1	21.2	23.3	25.5	29.7	34.0	38.2	42.4	46.7
5	11.5	13.4	15.3	17.2	19.1	21.0	22.9	26.7	30.6	34.4	38.2	42.0
5 1/2	10.4	12.2	13.9	15.6	17.4	19.1	20.8	24.3	27.8	31.3	34.7	38.2
6	9.5	11.1	12.7	14.3	15.9	17.5	19.1	22.3	25.5	28.6	31.8	35.0
6 1/2	8.8	10.3	11.8	13.2	14.7	16.2	17.6	20.6	23.5	26.4	29.4	32.3
7	8.2	9.5	10.9	12.3	13.6	15.0	16.4	19.1	21.8	24.5	27.3	30.0
7 1/2	7.6	8.9	10.2	11.5	12.7	14.0	15.3	17.8	20.4	22.9	25.5	28.0
8	7.2	8.4	9.5	10.7	11.9	13.1	14.3	16.7	19.1	21.5	23.9	26.3
8 1/2	6.7	7.9	9.0	10.1	11.2	12.4	13.5	15.7	18.0	20.2	22.5	24.7
9	6.4	7.4	8.5	9.5	10.6	11.7	12.7	14.9	17.0	19.1	21.2	23.3
9 1/2	6.0	7.0	8.0	9.1	10.1	11.1	12.1	14.1	16.1	18.1	20.1	22.1
10	5.7	6.7	7.6	8.6	9.5	10.5	11.5	13.4	15.3	17.2	19.1	21.0
11	5.2	6.1	6.9	7.8	8.7	9.5	10.4	12.2	13.9	15.6	17.4	19.1
12	4.8	5.6	6.4	7.2	8.0	8.8	9.5	11.1	12.7	14.3	15.9	17.5
Ft. per	15	17.5	20	22.5	25	27.5	30	35	40	45	50	55

Continued on page 11

Table of Cutting Speeds—continued

Ft. per Min.	60	65	70	75	80	90	100	110	120	130	140	150
Diam. In.	REVOLUTIONS PER MINUTE											
1/16	3667	3973	4278	4584	4889	...	...	...	...	...	...	...
1/8	1833	1986	2139	2292	2445	2750	3056	3361	3667	3973	4278	4584
3/16	1222	1324	1426	1528	1630	1833	2037	2241	2445	2648	2852	3056
1/4	917	993	1070	1146	1222	1375	1528	1681	1833	1986	2139	2292
5/16	733	794	856	917	978	1100	1222	1345	1467	1589	1711	1833
3/8	611	662	713	764	815	917	1019	1120	1222	1324	1426	1528
7/16	524	568	611	655	698	786	873	960	1048	1135	1222	1310
1/2	458	497	535	573	611	688	764	840	917	993	1070	1146
5/8	367	397	428	458	489	550	611	672	733	794	856	917
3/4	306	331	357	382	407	458	509	560	611	662	713	764
7/8	262	284	306	327	349	393	437	480	524	568	611	655
1	229	248	267	287	306	344	382	420	458	497	535	573
1 1/8	204	221	238	255	272	306	340	373	407	441	475	509
1 1/4	183	199	214	229	244	275	306	336	367	397	428	458
1 3/8	167	181	194	208	222	250	278	306	333	361	389	417
1 1/2	153	166	178	191	204	229	255	280	306	331	357	382
1 5/8	141	153	165	176	188	212	235	259	282	306	329	353
1 3/4	131	142	153	164	175	196	218	240	262	284	306	327
1 7/8	122	132	143	153	163	183	204	224	244	265	285	306
2	115	124	134	143	153	172	191	210	229	248	267	287
2 1/4	102	110	119	127	136	153	170	187	204	221	238	255
2 1/2	91.7	99.3	107	115	122	138	153	168	183	199	214	229
2 3/4	83.3	90.3	97.2	104	111	125	139	153	167	181	194	208
3	76.4	82.8	89.1	95.5	102	115	127	140	153	166	178	191
3 1/4	70.5	76.4	82.3	88.2	94.0	106	118	129	141	153	165	176
3 1/2	65.5	70.9	76.4	81.9	87.3	98.2	109	120	131	142	153	164
3 3/4	61.1	66.2	71.3	76.4	81.5	91.7	102	112	122	132	143	153
4	57.3	62.1	66.8	71.6	76.4	85.9	95.9	105	115	124	134	143
4 1/2	50.9	55.2	59.4	63.6	67.9	76.4	84.9	93.4	102	110	119	127
5	45.8	49.7	53.5	57.3	61.1	68.8	76.4	84.0	91.7	99.3	107	115
5 1/2	41.7	45.1	48.6	52.1	55.6	62.5	69.5	76.4	83.3	90.3	97.2	104
6	38.2	41.4	44.6	47.8	50.9	57.3	63.7	70.0	76.4	82.8	89.1	95.5
6 1/2	35.3	38.2	41.1	44.1	47.0	52.9	58.8	64.6	70.5	76.4	82.3	88.2
7	32.7	35.5	38.2	40.9	43.7	49.1	54.6	60.0	65.5	70.9	76.4	81.9
7 1/2	30.6	33.1	35.7	38.2	40.7	45.8	50.9	56.0	61.1	66.2	71.3	76.4
8	28.7	31.0	33.4	35.8	38.2	43.0	47.7	52.5	57.3	62.1	66.8	71.6
8 1/2	27.0	29.2	31.5	33.7	36.0	40.4	44.9	49.4	53.9	58.4	62.9	67.4
9	25.5	27.6	29.7	31.8	34.0	38.2	42.4	46.7	50.9	55.2	59.4	63.6
9 1/2	24.1	26.1	28.2	30.2	32.2	36.2	40.2	44.2	48.3	52.3	56.3	60.3
10	22.9	24.8	26.7	28.7	30.6	34.4	38.2	42.0	45.8	49.7	53.5	57.3
11	20.8	22.6	24.3	26.0	27.8	31.3	34.7	38.2	41.7	45.1	48.6	52.1
12	19.1	20.7	22.3	23.9	25.5	28.6	31.8	35.0	38.2	41.4	44.6	47.8
Ft. per	60	65	70	75	80	90	100	110	120	130	140	150

Milling Cutters

Milling Cutter:—

"A fluted sharp edged, rotary cutter for dressing surfaces as of metal of various shapes."

This definition of Milling Cutters covers all cutters shown in this catalog.

For convenience cutters are given different names for various operations and the illustrations, with sizes, kind and lists, cover cutters regularly carried in stock.

Cutters varying from those shown in this Catalog are special and can be made to order promptly.

Hand of Rotation of Milling Cutters

The hand of rotation of any cutter may be determined by looking at the cutter end of spindle. If the cutter rotates counterclockwise it is a right hand cutter; if it rotates clockwise it is left hand.

See page 165 for diagram showing suggestion for clearing, when width of land is increased due to repeated grinding and secondary clearance becomes necessary.

Suggestions When Ordering Cutters

ALWAYS SPECIFY CARBON OR HIGH SPEED STEEL

STOCK CUTTERS:—Specify Style or Type of cutter required, also Catalog Number. On cutters or mills that are furnished either Right or Left Hand specify the hand required.

SPECIAL CUTTERS:—Specify the Type of cutter required, giving dimensions in full, and if possible furnish sketch or blueprint. In ordering Formed Cutters, send template when possible. When extreme accuracy is required we are prepared to grind Formed Cutters to close tolerances. On both Shaped Profile and Formed Cutters, always indicate on drawing direction of revolution of cutter, that is whether cutter runs "Coming" or "Going" at bottom, also tolerances. In ordering Arbor Type Cutters, always specify size of keyway (see Page 8). We should also know under what conditions and the character of material on which cutter is to be used.

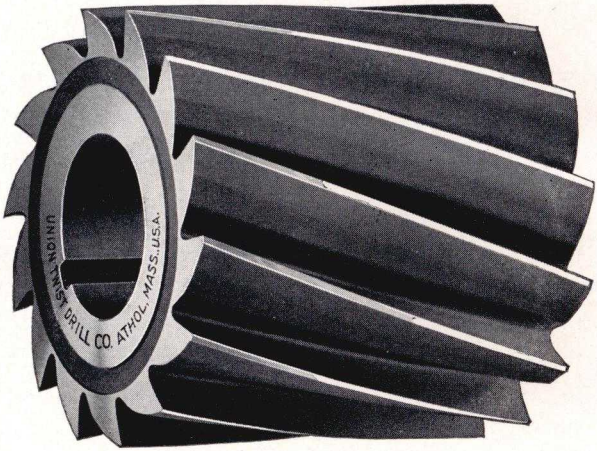
GEAR CUTTERS:—Stock and Special—Give Range Number (see Page 59), pitch, outside diameter, size of hole, keyway, stating clearly whether DIAMETRAL or CIRCULAR pitch.

We are prepared to lay out and design cutters singly, or in gangs, for all milling operations, and to submit estimates and drawings upon receipt of necessary data.

Telegraph, Telephone, Verbal orders and instructions should be confirmed in writing.

Plain Milling Cutters

UNDERCUT TEETH



Plain Milling Cutters of less than ¾″ face have straight teeth.

Plain Milling Cutters are made with undercut teeth having the proper angle of spiral. The teeth are designed to afford maximum strength without increasing width of land too quickly when sharpening, and leaving ample chip space in the fillet.

Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
A2	2¼	½	⅞	$2.30	$ 4.50
A3	2¼	1	⅞	3.00	6.00
A5	2½	3/16	1	1.60	3.10
A6	2½	¼	1	2.10	4.10
A7	2½	5/16	1	2.20	4.30
A8	2½	⅜	1	2.30	4.60
A9	2½	7/16	1	2.50	4.90
A10	2½	½	1	2.60	5.10
A12	2½	⅝	1	2.80	5.60
A14	2½	¾	1	3.00	6.00
A18	2½	1	1	3.50	6.90
A21	2½	1½	1	4.30	8.60
A23	2½	2	1	5.20	10.30
A25	2½	2½	1	6.10	12.10
A27	2½	3	1	6.90	13.70

For Keyway see page 8.

List continued on page 15

Plain Milling Cutters—continued

UNDERCUT TEETH

Plain Milling Cutters of less than ¾″ face have straight teeth

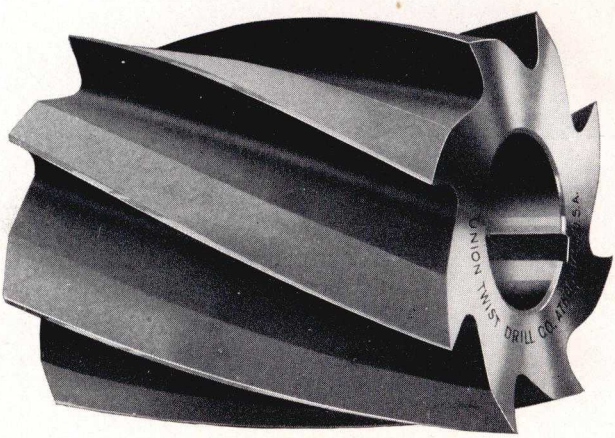
Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
A57	3	3/16	1	$ 1.90	$ 3.80
A58	3	1/4	1	2.50	5.00
A59	3	5/16	1	2.70	5.40
A60	3	3/8	1	2.90	5.70
A61	3	3/8	1 1/4	2.90	5.70
A63	3	7/16	1 1/4	3.00	6.00
A65	3	1/2	1 1/4	3.20	6.40
A67	3	5/8	1 1/4	3.50	6.90
A69	3	3/4	1 1/4	3.80	7.50
A71	3	7/8	1 1/4	4.10	8.10
A73	3	1	1 1/4	4.40	8.70
A74	3	1 1/4	1 1/4	5.00	9.90
A75	3	1 1/2	1 1/4	5.50	11.00
A77	3	2	1 1/4	6.70	13.40
A79	3	3	1 1/4	9.10	18.10
A108	4	1/4	1	3.60	7.10
A109	4	1/4	1 1/4	3.60	7.10
A110	4	5/16	1	3.90	7.70
A111	4	5/16	1 1/4	3.90	7.70
A112	4	3/8	1	4.10	8.20
A113	4	3/8	1 1/4	4.10	8.20
A115	4	1/2	1 1/4	4.70	9.30
A118	4	5/8	1 1/4	5.10	10.20
A120	4	3/4	1 1/4	5.60	11.20
A125	4	1	1 1/4	6.60	13.10
A129	4	1 1/2	1 1/4	8.60	17.10
A133	4	2	1 1/4	10.50	21.00
A136	4	3	1 1/4	14.50	28.90
A139	4	4	1 1/4	18.40	36.80

For Keyway see page 8.

Coarse Tooth—Plain Milling Cutters

UNDERCUT TEETH

HIGH SPEED STEEL



Coarse Tooth Milling Cutters have a sharper spiral and fewer number of teeth than the Plain Milling Cutters.

The wide spacing of teeth allows ample chip room and makes possible an exceptionally strong tooth.

Coarse Tooth Milling Cutters require less power than the Plain Milling Cutters, due to the fewer number of teeth in contact with the work.

Carbon Steel Coarse Tooth Milling Cutters are special. Prices on application.

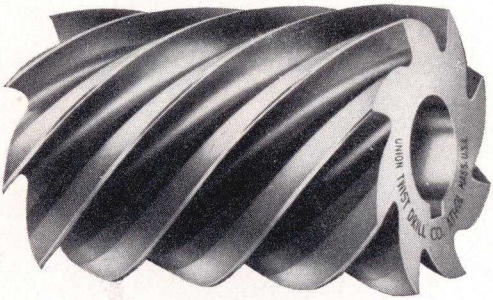
Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
A563	2½	2	1	$ 10.30
A569	2½	4	1	17.30
A583	3	2	1¼	13.40
A584	3	2½	1¼	15.80
A585	3	3	1¼	18.10
A587	3	4	1¼	22.80
A589	3	6	1¼	33.60
A644	4	2	1½	21.00
A647	4	3	1½	28.90
A650	4	4	1½	36.80
A654	4	6	1½	53.90
A655	4½	6	2	66.30
A656	4½	12	2	136.60

For Keyway see page 8.

Helical Plain Milling Cutters

UNDERCUT TEETH

HIGH SPEED STEEL



Helical Plain Milling Cutters cut with a shearing action due to the quick spiral and rake angle of teeth, and when run at high speeds and feeds, leave a very smooth finish.

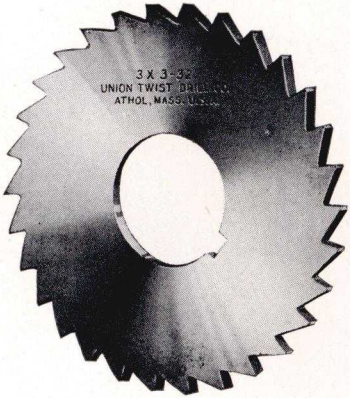
Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
A300	3	4	1¼	$ 25.10
A301	3	6	1¼	37.00
A302	4	4	1½	40.50
A303	4	6	1½	59.30
A304	4	8	1½	80.60
A305	4	10	1½	101.90
A306	4½	6	2	72.90
A307	4½	12	2	150.30

Carbon Steel Helical Milling Cutters are special. Prices on application.

For Keyway see page 8.

Metal Slitting Saws

CONCAVE SIDES



Thin milling cutters accurately made for use on metals. Clearance is gained by grinding saws concave on the sides, leaving the cutting edge thicker than any other part of the saw.

Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
M1	2 1/2	1/32	7/8	$1.40	$2.80
M3	2 1/2	3/64	7/8	1.40	2.80
M5	2 1/2	1/16	7/8	1.40	2.80
M7	2 1/2	3/32	7/8	1.40	2.80
M9	2 1/2	1/8	7/8	1.50	2.90
M13	3	1/32	1	1.70	3.30
M15	3	3/64	1	1.70	3.30
M17	3	1/16	1	1.70	3.40
M19	3	3/32	1	1.70	3.40
M21	3	1/8	1	1.80	3.50
M23	3	5/32	1	1.90	3.70

For Metal Slitting Saws with Side Chip Clearance see page 20.
For Metal Slitting Saws with Staggered Teeth and Side Chip Clearance see page 21.
For Keyway see page 8.

List continued on page 19

Metal Slitting Saws—continued

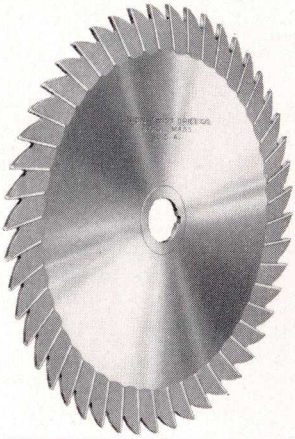
CONCAVE SIDES

Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
M25	4	1/32	1	$2.20	$ 4.30
M27	4	3/64	1	2.20	4.40
M29	4	1/16	1	2.30	4.50
M31	4	3/32	1	2.40	4.70
M33	4	1/8	1	2.50	5.00
M35	4	5/32	1	2.60	5.20
M37	4	3/16	1	2.80	5.50
M39	5	1/16	1	2.90	5.80
M41	5	3/32	1	3.20	6.30
M43	5	1/8	1	3.30	6.60
M45	5	1/8	1 1/4	3.30	6.60
M49	5	5/32	1	3.50	7.00
M51	5	3/16	1	3.70	7.40
M53	6	1/16	1	3.70	7.30
M55	6	3/32	1	4.20	8.40
M57	6	1/8	1	4.30	8.60
M57 1/4	6	1/8	1 1/4	4.30	8.60
M59	6	3/16	1	5.20	10.40
M60	6	3/16	1 1/4	5.20	10.40
M70	8	1/8	1	8.80	17.50
M71	8	1/8	1 1/4	8.80	17.50
M73	8	3/16	1 1/4	9.90	19.80

For Metal Slitting Saws with Side Chip Clearance see page 20.

For Metal Slitting Saws with Staggered Teeth and Side Chip Clearance see page 21.

For Keyway see page 8.



Metal Slitting Saws

With Side Chip Clearance

UNDERCUT TEETH

HIGH SPEED STEEL

This type of Saw is similar to a thin Side Milling Cutter, being especially designed for slotting and will be found particularly well adapted for deep cuts in steel.

For widths of 3/16 inch and over, we recommend Saws with Staggered Teeth, see page 21.

Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
M100	2 1/2	1/16	7/8	$ 5.20
M101	2 1/2	3/32	7/8	5.10
M102	2 1/2	1/8	7/8	5.10
M103	3	1/16	1	6.10
M104	3	3/32	1	6.00
M105	3	1/8	1	6.00
M106	3	5/32	1	6.10
M107	4	1/16	1	7.90
M108	4	3/32	1	7.90
M109	4	1/8	1	8.10
M110	4	5/32	1	8.30
M111	4	3/16	1	8.60
M112	5	1/16	1	9.80
M113	5	3/32	1	10.10
M114	5	1/8	1	10.40
M115	5	1/8	1 1/4	10.40
M116	5	5/32	1	10.70
M117	5	3/16	1	11.20
M118	6	1/16	1	12.00
M119	6	3/32	1	12.80
M120	6	1/8	1	13.10
M121	6	1/8	1 1/4	13.10
M122	6	3/16	1	14.80
M123	6	3/16	1 1/4	14.80
M124	8	1/8	1	26.90
M125	8	1/8	1 1/4	26.90
M126	8	3/16	1 1/4	29.00

Carbon Steel Metal Slitting Saws with Side Chip Clearance are special. Prices on application.

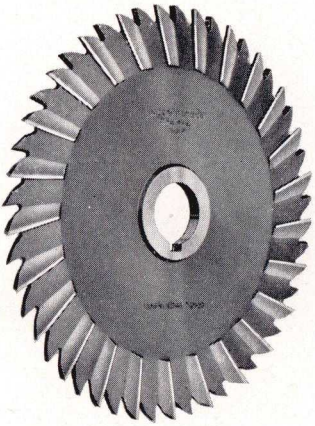
For Metal Slitting Saws with Concave Sides see pages 18–19.
For Metal Slitting Saws with Staggered Teeth and Side Chip Clearance see page 21.
For Keyway see page 8.

Metal Slitting Saws

With Staggered Teeth and Side Chip Clearance

UNDERCUT TEETH

HIGH SPEED STEEL



The Saws listed below have staggered teeth, undercut, and side chip clearance, and the cutting action is like that of the Staggered Tooth Side Milling Cutters shown on pages 32–33. We recommend this type of Saw for widths of 3/16 inch and over. For thinner widths we suggest using Metal Slitting Saws with Side Chip Clearance, see page 20.

Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
M200	3	3/16	1	$ 7.80
M201	4	3/16	1	10.80
M202	5	3/16	1	14.00
M203	5	1/4	1	14.80
M204	6	3/16	1	18.50
M205	6	3/16	1 1/4	18.50
M206	6	1/4	1	18.90
M207	6	1/4	1 1/4	18.90
M208	8	3/16	1 1/4	36.30
M209	8	1/4	1 1/4	37.40

Carbon Steel Metal Slitting Saws with Staggered Teeth and Side Chip Clearance are special. Prices on application.

For Metal Slitting Saws with Concave Sides, see pages 18–19.
For Metal Slitting Saws with Side Chip Clearance, see page 20.
For Keyway, see page 8.

Special Formed Metal Slitting Saws

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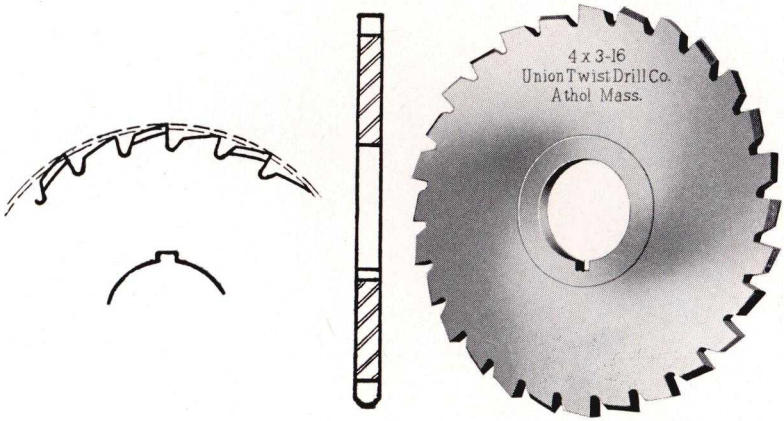
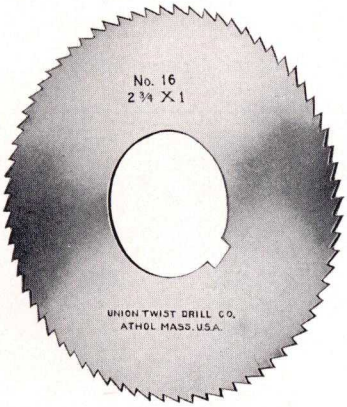


Formed Metal Slitting Saws are sometimes used for cutting copper and other materials of a tough stringy nature. The teeth are given a good radial clearance and are so constructed as to break up and throw out the chips preventing to a great extent the clogging of the Saw. Sides are ground concave for clearance. These Saws are sharpened by grinding the face of the teeth same as in any formed cutter.

Formed Metal Slitting Saws, both Carbon and High Speed Steel are made to order. Prices on application.

Screw Slotting Cutters

CARBON AND HIGH SPEED STEEL



Union Screw Slotting Cutters have a fine pitch of teeth and as the name implies, are especially adapted for slotting screw heads. Where shallow cuts are required these Cutters are found desirable for many purposes other than slotting screw heads.

High Speed Steel Screw Slotting Cutters are ground on the sides after hardening.

In ordering, always give diameter, number or thickness, and size hole. When High Speed Steel Cutters are wanted also specify the number of teeth.

For sizes and list prices of Screw Slotting Cutters carried in stock, see pages 24–27.

Continued on page 24

Screw Slotting Cutters

CARBON STEEL

Carbon Steel Screw Slotting Cutters 2¾″ diameter are regularly made with 72 teeth; 2¼″ diameter, 60 teeth; and 1¾″ diameter, 90 teeth.

In ordering, always give diameter, number or thickness, and size hole.

Carbon Steel Screw Slotting Cutters are not ground on the sides.

Catalog No.	Am. Std. Wire Gauge No.	Dimensions—Inches			Price Each Carbon Steel
		Width Face	Diameter	Size Hole	
P1	5	.182	2¾	1	$1.15
P2	6	.162	2¾	1	.95
P3	7	.144	2¾	1	.85
P4	8	.128	2¾	¾, 1	.70
P5	9	.114	2¾	¾, 1	.65
P6	10	.102	2¾	¾, 1	.60
P7	11	.091	2¾	¾, 1	.55
P8	12	.081	2¾	¾, 1	.55
P9	13	.072	2¾	¾, 1	.55
P10	14	.064	2¾	½, ⅝, ¾, 1	.55
P11	15	.057	2¾	½, ⅝, ¾, 1	.50
P12	16	.051	2¾	½, ⅝, ¾, 1	.50
P13	17	.045	2¾	½, ⅝, ¾, 1	.35
P14	18	.040	2¾	½, ⅝, ¾, 1	.35
P15	19	.036	2¾	½, ⅝, ¾, 1	.35
P16	20	.032	2¾	½, ⅝, ¾, 1	.35
P17	21	.028	2¾	½, ⅝, ¾, 1	.30
P18	22	.025	2¾	½, ⅝, ¾, 1	.30
P19	23	.023	2¾	½, ⅝, ¾, 1	.30
P20	24	.020	2¾	½, ⅝, ¾, 1	.30
P21	25	.018	2¾	½, ⅝, ¾, 1	.30
P22	26	.016	2¾	¾, 1	.30
P23	27	.014	2¾	¾, 1	.30
P24	28	.013	2¾	¾, 1	.30
P25	30	.010	2¾	¾, 1	.30
P26	32	.008	2¾	¾, 1	.30
P27	34	.006	2¾	¾, 1	.30
P28	10	.102	2¼	⅝	.55
P29	11	.091	2¼	⅝	.50
P30	12	.081	2¼	⅝	.50

For High Speed Steel Screw Slotting Cutters see pages 26–27.
For Keyway see page 8.
List continued on page 25

Screw Slotting Cutters—continued

CARBON STEEL

Catalog No.	Am. Std. Wire Gauge No.	Dimensions—Inches			Price Each Carbon Steel
		Width Face	Diameter	Size Hole	
P31	13	.072	2¼	⅝	$0.35
P32	14	.064	2¼	⅝	.35
P33	15	.057	2¼	⅝	.30
P34	16	.051	2¼	⅝	.30
P35	17	.045	2¼	⅝	.30
P36	18	.040	2¼	⅝	.30
P37	19	.036	2¼	⅝	.30
P38	20	.032	2¼	⅝	.30
P39	21	.028	2¼	⅝	.30
P40	22	.025	2¼	⅝	.30
P41	23	.023	2¼	⅝	.30
P42	24	.020	2¼	⅝	.30
P43	25	.018	2¼	⅝	.30
P44	26	.016	2¼	⅝	.30
P45	27	.014	2¼	⅝	.30
P46	28	.013	2¼	⅝	.30
P47	30	.010	2¼	⅝	.30
P48	32	.008	2¼	⅝	.30
P49	34	.006	2¼	⅝	.30
P50	14	.064	1¾	⅝	.30
P51	15	.057	1¾	⅝	.30
P52	16	.051	1¾	⅝	.30
P53	17	.045	1¾	⅝	.30
P54	18	.040	1¾	⅝	.30
P55	19	.036	1¾	⅝	.30
P56	20	.032	1¾	⅝	.30
P57	21	.028	1¾	⅝	.30
P58	22	.025	1¾	⅝	.30
P59	23	.023	1¾	⅝	.30
P60	24	.020	1¾	½, ⅝	.25
P61	25	.018	1¾	½, ⅝	.25
P62	26	.016	1¾	½, ⅝	.25
P63	27	.014	1¾	½, ⅝	.25
P64	28	.013	1¾	½, ⅝	.25
P65	30	.010	1¾	½, ⅝	.25
P66	32	.008	1¾	½, ⅝	.25
P67	34	.006	1¾	½, ⅝	.25

For High Speed Steel Screw Slotting Cutters see pages 26–27.
For Keyway see page 8.

Screw Slotting Cutters

HIGH SPEED STEEL

High Speed Steel Screw Slotting Cutters 2¾″ diameter, 1″ hole, are carried in stock with 44, 56 or 72 teeth; 2¾″ diameter, ¾″ hole, 72 teeth; 2¼″ diameter, ⅝″ hole, 60 teeth; and 1¾″ diameter, ⅝″ hole, 90 teeth.

High Speed Steel Screw Slotting Cutters are ground on the sides.

In ordering, always give diameter, number or thickness, size hole and number of teeth.

Catalog No.	Am. Std. Wire Gauge No.	Dimensions—Inches			Price Each High Speed Steel
		Width Face	Diameter	Size Hole	
P70	6	.162	2¾	1	$3.20
P71	7	.144	2¾	1	3.00
P72	8	.128	2¾	¾, 1	2.75
P73	9	.114	2¾	¾, 1	2.50
P74	10	.102	2¾	¾, 1	2.30
P75	11	.091	2¾	¾, 1	2.05
P76	12	.081	2¾	¾, 1	1.90
P77	13	.072	2¾	¾, 1	1.90
P78	14	.064	2¾	¾, 1	1.80
P79	15	.057	2¾	¾, 1	1.70
P80	16	.051	2¾	¾, 1	1.60
P81	17	.045	2¾	¾, 1	1.55
P82	18	.040	2¾	¾, 1	1.50
P83	19	.036	2¾	¾, 1	1.50
P84	20	.032	2¾	¾, 1	1.50
P85	21	.028	2¾	¾, 1	1.50
P86	22	.025	2¾	¾, 1	1.50
P87	23	.023	2¾	¾, 1	1.50
P88	24	.020	2¾	¾, 1	1.50

For Carbon Steel Screw Slotting Cutters see pages 24–25.
For Keyway see page 8.

List continued on page 27

Screw Slotting Cutters—continued

HIGH SPEED STEEL

High Speed Steel Screw Slotting Cutters 2¾″ diameter, 1″ hole, are carried in stock with 44, 56 or 72 teeth; 2¾″ diameter, ¾″ hole, 72 teeth; 2¼″ diameter, ⅝″ hole, 60 teeth; and 1¾″ diameter, ⅝″ hole, 90 teeth.

High Speed Steel Screw Slotting Cutters are ground on the sides.

In ordering, always give diameter, number or thickness, size hole and number of teeth.

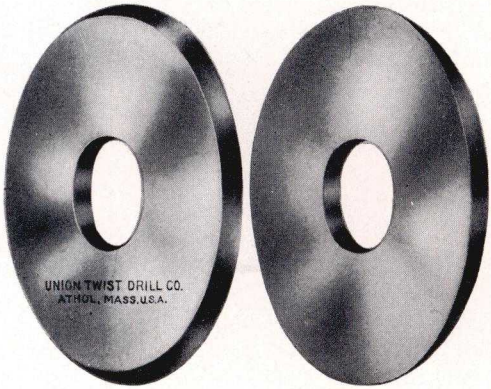
Catalog No.	Am. Std. Wire Gauge No.	Dimensions—Inches			Price Each High Speed Steel
		Width Face	Diameter	Size Hole	
P100	14	.064	2¼	⅝	$1.75
P101	15	.057	2¼	⅝	1.60
P102	16	.051	2¼	⅝	1.50
P103	17	.045	2¼	⅝	1.50
P104	18	.040	2¼	⅝	1.45
P105	19	.036	2¼	⅝	1.45
P106	20	.032	2¼	⅝	1.45
P107	21	.028	2¼	⅝	1.45
P108	22	.025	2¼	⅝	1.45
P109	23	.023	2¼	⅝	1.45
P110	24	.020	2¼	⅝	1.45
P120	14	.064	1¾	⅝	1.75
P121	15	.057	1¾	⅝	1.60
P122	16	.051	1¾	⅝	1.50
P123	17	.045	1¾	⅝	1.50
P124	18	.040	1¾	⅝	1.45
P125	19	.036	1¾	⅝	1.45
P126	20	.032	1¾	⅝	1.45
P127	21	.028	1¾	⅝	1.45
P128	22	.025	1¾	⅝	1.45
P129	23	.023	1¾	⅝	1.45
P130	24	.020	1¾	⅝	1.45

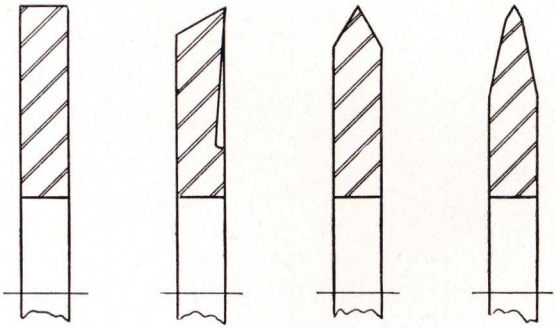
For Carbon Steel Screw Slotting Cutters see pages 24–25.

For Keyway see page 8.

Circular Metal Slitting Shears

CARBON AND HIGH SPEED STEEL





We are prepared to furnish promptly to order Slitting Shears such as are commonly used for cutting thin sheet metals, paper, cloth and other materials made in various forms for particular requirements.

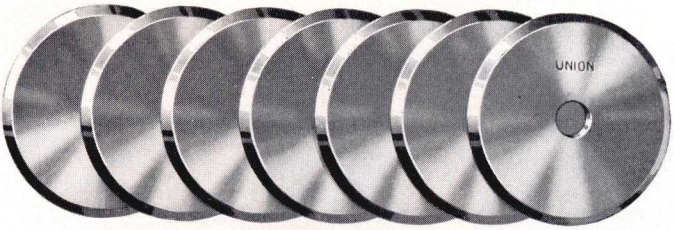
They are usually finished all over by grinding. The edge is ground either square or beveling. The bevel may be all on one side, or on both sides, to bring the cutting edge central as may be required.

Prices quoted on application.

Continued on page 29

Circular Metal Slitting Shears—continued

CARBON AND HIGH SPEED STEEL



Made in Gangs, with or without Collars

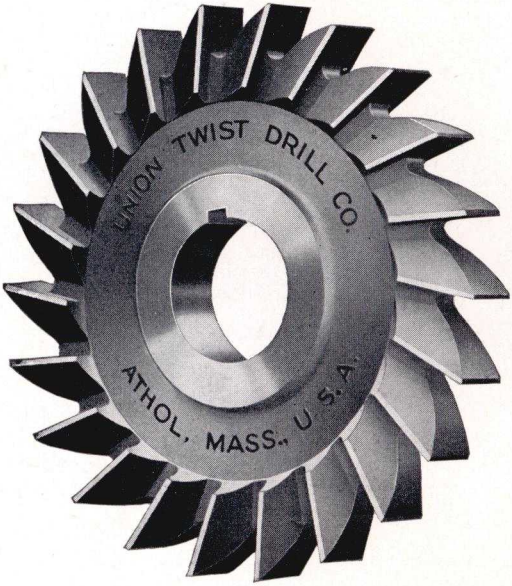
With the growing demand for close limits in slitting thin material we are prepared to furnish gangs of Slitters, with or without Spacing Collars, ground to close limits for slitting materials closely uniform in width.

All our slitters are made from specially selected steel, carefully heat treated.

Prices quoted on application.

Side Milling Cutters

UNDERCUT TEETH



Side Milling Cutters have undercut teeth and are especially designed to give strength with ample chip room. The form of tooth permits of repeated grinding, giving a much longer life.

These cutters are very well adapted for a wide variety of production operations and are quite commonly used for straddle milling, although, we particularly recommend Half Side Milling Cutters for this purpose.

Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
B301	2	3/16	1/2	$2.10	$4.20
B304	2	3/16	5/8	2.10	4.20
B302	2	1/4	1/2	2.20	4.40
B305	2	1/4	5/8	2.20	4.40
B303	2	3/8	1/2	2.40	4.80
B306	2	3/8	5/8	2.40	4.80
B307	2 1/2	1/4	7/8	2.70	5.40
B308	2 1/2	5/16	7/8	2.90	5.70
B309	2 1/2	3/8	7/8	3.00	6.00
B311	2 1/2	1/2	7/8	3.30	6.60

For Staggered Tooth Side Milling Cutters see pages 32–33.
For Half Side Milling Cutters see page 34.
For Keyway see page 8.
List continued on page 31

Side Milling Cutters—continued

UNDERCUT TEETH

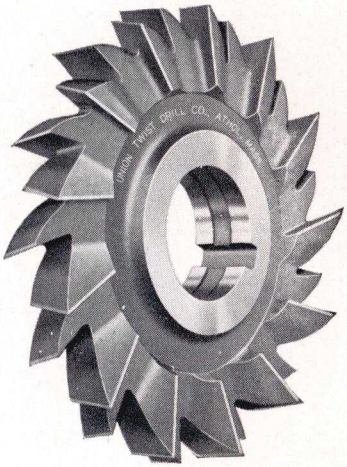
Catalog No.	Dimensions—Inches			Price Each	
	Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
B320	3	1/4	1	$ 3.30	$ 6.50
B321	3	5/16	1	3.50	6.90
B322	3	3/8	1	3.60	7.20
B324	3	7/16	1	3.80	7.60
B325	3	1/2	1	4.00	8.00
B332	4	1/4	1	4.50	9.00
B334	4	3/8	1	5.10	10.10
B336	4	1/2	1	5.70	11.30
B337	4	1/2	1 1/4	5.70	11.30
B339	4	5/8	1	6.20	12.30
B340	4	5/8	1 1/4	6.20	12.30
B341	4	3/4	1	6.70	13.30
B342	4	3/4	1 1/4	6.70	13.30
B343	4	7/8	1	7.20	14.30
B344	4	7/8	1 1/4	7.20	14.30
B354	5	1/2	1	7.60	15.10
B355	5	1/2	1 1/4	7.60	15.10
B356	5	5/8	1	8.40	16.70
B357	5	5/8	1 1/4	8.40	16.70
B358	5	3/4	1	9.10	18.20
B359	5	3/4	1 1/4	9.10	18.20
B363	5	1	1 1/4	10.70	21.30
B364	6	1/2	1	9.90	19.70
B365	6	1/2	1 1/4	9.90	19.70
B367	6	5/8	1 1/4	10.90	21.80
B369	6	3/4	1	12.00	24.00
B370	6	3/4	1 1/4	12.00	24.00
B374	6	1	1 1/4	14.20	28.40
B376	7	3/4	1 1/4	17.20	34.40
B377	7	1	1 1/4	20.20	40.30
B377 1/2	8	3/4	1 1/4	22.90	45.70
B378	8	1	1 1/4	26.70	53.40

For Staggered Tooth Side Milling Cutters see pages 32–33.
For Half Side Milling Cutters see page 34.
For Keyway see page 8.

Staggered Tooth Side Milling Cutters

UNDERCUT TEETH

HIGH SPEED STEEL



Staggered Tooth Side Milling Cutters are especially designed for keyway and deep slotting work. The teeth are alternately right and left hand spiral, undercut, with ample chip room and give a free cutting action. This type of cutter can be run at an increased speed and feed, removing a large quantity of metal without vibration or chatter, leaving a smooth finish.

Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
B395	2 1/2	1/4	7/8	$6.80
B396	2 1/2	5/16	7/8	7.10
B397	2 1/2	3/8	7/8	7.50
B398	2 1/2	1/2	7/8	8.30
B404 1/8	3	3/16	1	7.80
B404 1/4	3	1/4	1	8.10
B404 1/2	3	5/16	1	8.60
B405 1/2	3	3/8	1	9.00

Carbon Steel Staggered Tooth Side Milling Cutters are special. Prices on application.

For Side Milling Cutters see pages 30–31.

For Half Side Milling Cutters see page 34.

For Keyway see page 8.

List continued on page 33

Staggered Tooth Side Milling Cutters—continued

UNDERCUT TEETH

HIGH SPEED STEEL

Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
B407	3	1/2	1 1/4	$10.00
B408	3	5/8	1 1/4	10.80
B409	3	3/4	1 1/4	11.50
B409 1/8	4	1/4	1 1/4	11.30
B409 1/4	4	5/16	1 1/4	12.00
B409 3/8	4	3/8	1 1/4	12.60
B409 1/2	4	7/16	1 1/4	13.40
B410	4	1/2	1 1/4	14.10
B411	4	5/8	1 1/4	15.40
B412	4	3/4	1 1/4	16.60
B413	4	7/8	1 1/4	17.90
B414	5	1/2	1 1/4	18.90
B415	5	5/8	1 1/4	20.90
B416	5	3/4	1 1/4	22.80
B418 1/2	6	3/8	1 1/4	21.80
B419	6	1/2	1 1/4	24.60
B420	6	5/8	1 1/4	27.30
B421	6	3/4	1 1/4	30.00
B422	6	7/8	1 1/4	32.80
B423	6	1	1 1/4	35.50
B428 1/2	8	3/8	1 1/2	42.40
B429 1/2	8	1/2	1 1/2	47.40
B430 1/2	8	5/8	1 1/2	52.30
B431 1/2	8	3/4	1 1/2	57.10

Carbon Steel Staggered Tooth Side Milling Cutters are special. Prices on application.

For Side Milling Cutters see pages 30–31.

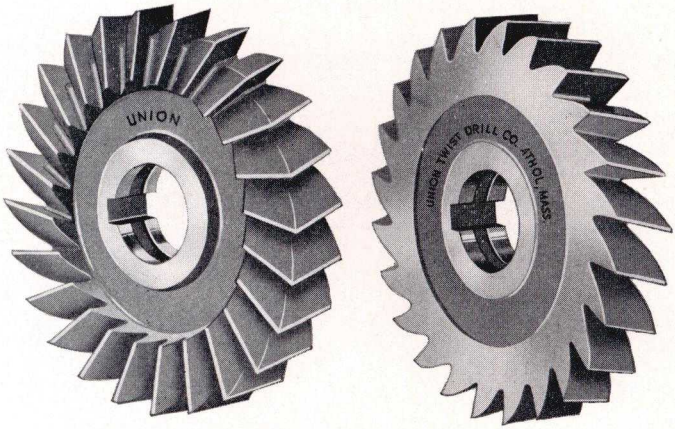
For Half Side Milling Cutters see page 34.

For Keyway see page 8.

Half Side Milling Cutters

UNDERCUT TEETH

HIGH SPEED STEEL



Half Side Milling Cutters are designed for side cuts where one side only is required. This type of cutter is particularly recommended for straddle milling operations. The spiral, undercut teeth with ample chip room produce a free smooth cutting action and the deep cut side teeth give a much longer sharpening life.

These cutters are carried in stock both Right and Left Hand. When ordering state Hand required.

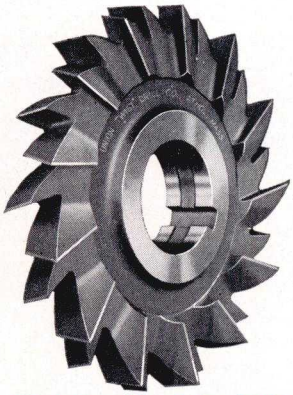
Catalog No.	Dimensions—Inches			Price Each High Speed Steel
	Diameter	Width Face	Size Hole	
B103	4	¾	1¼	$13.30
B107	5	¾	1¼	18.20
B113½	6	¾	1¼	24.00
B114	6	1	1½	28.40
B119½	7	¾	1½	34.40
B120	7	1	1½	40.30
B125¼	8	¾	1½	45.70
B125½	8	1	1½	53.40

Carbon Steel Half Side Milling Cutters are special. Prices on application.

For Side Milling Cutters see pages 30–31.
For Staggered Tooth Side Milling Cutters see pages 32–33.
For Keyway see page 8.

Woodruff Keyseat Cutters

ARBOR TYPE
UNDERCUT TEETH



Woodruff Keyseat Cutters Arbor Type are regularly furnished with staggered teeth. Side teeth are relieved to leave a narrow margin. They are of the correct dimensions for Woodruff keys and are regularly furnished with diameters 1/32″ larger than listed below to allow for sharpening.

Keys and cutters correspond in size and number with the exceptions as noted at the bottom of the page.

Carbon Steel No. W200 — High Speed Steel No. W600

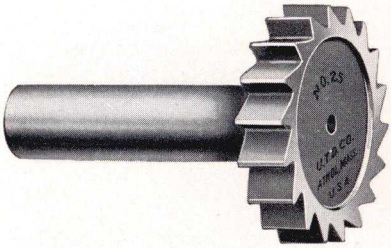
No. of Cutter	Dimensions—Inches			Price Each	
	Nominal Diam.	Width Face	Size Hole	Carbon Steel	High Speed Steel
26	2 1/8	3/16	3/4	$3.00	5.90
27	2 1/8	1/4	3/4	3.10	6.10
28	2 1/8	5/16	3/4	3.20	6.40
29	2 1/8	3/8	3/4	3.40	6.80
R	2 3/4	1/4	1	3.70	7.40
S	2 3/4	5/16	1	4.00	7.90
T	2 3/4	3/8	1	4.20	8.30
U	2 3/4	7/16	1	4.30	8.60
V	2 3/4	1/2	1	4.50	9.00
30	3 1/2	3/8	1	5.40	10.80
31	3 1/2	7/16	1	5.70	11.40
32	3 1/2	1/2	1	6.00	11.90
33	3 1/2	9/16	1	6.50	12.90
34	3 1/2	5/8	1	6.50	12.90
35	3 1/2	11/16	1	7.00	13.90
36	3 1/2	3/4	1	7.00	13.90

For Key No. 126 Use Cutter No. 26
For Key No. 127 Use Cutter No. 27
For Key No. 128 Use Cutter No. 28
For Key No. 129 Use Cutter No. 29
For Key No. RX Use Cutter No. R
For Key No. SX Use Cutter No. S
For Key No. TX Use Cutter No. T
For Key No. UX Use Cutter No. U
For Key No. VX Use Cutter No. V

For Woodruff Keyseat Cutters Shank Type see pages 36–37.
For Keyway see page 8.

Woodruff Keyseat Cutters

SHANK TYPE



All sizes have uniform shank ½″ diameter.

Keys and cutters correspond in size and number with the exceptions as noted at the bottom of page 37.

Right Hand Cutters are carried in stock. Left Hand Cutters are special. Prices on application.

Carbon Steel No. W100 — High Speed Steel No. W500

Number of Cutter		Dimensions—Inches			Price Each	
*American Standard	Old Standard	Diameter	Width Face	Length Overall	Carbon Steel	High Speed Steel
...	201	1/4	1/16	2 1/16	$1.80	$3.50
...	206	5/16	1/16	2 1/16	1.80	3.50
...	207	5/16	3/32	2 3/32	1.80	3.50
...	211	3/8	1/16	2 1/16	1.80	3.50
...	212	3/8	3/32	2 3/32	1.80	3.50
...	213	3/8	1/8	2 1/8	1.80	3.50
204	1	1/2	1/16	2 1/16	1.40	2.80
304	2	1/2	3/32	2 3/32	1.40	2.80
305	4	5/8	3/32	2 3/32	1.40	2.80
404	3	1/2	1/8	2 1/8	1.40	2.80
405	5	5/8	1/8	2 1/8	1.40	2.80
406	7	3/4	1/8	2 1/8	1.60	3.10
505	6	5/8	5/32	2 5/32	1.40	2.80
...	61	5/8	3/16	2 3/16	1.40	2.80
506	8	3/4	5/32	2 5/32	1.60	3.10
...	91	3/4	1/4	2 1/4	1.60	3.10
507	10	7/8	5/32	2 5/32	1.70	3.40
606	9	3/4	3/16	2 3/16	1.60	3.10
607	11	7/8	3/16	2 3/16	1.70	3.40
...	12	7/8	7/32	2 7/32	1.70	3.40
608	13	1	3/16	2 3/16	1.90	3.80
...	14	1	7/32	2 7/32	1.90	3.80
...	152	1	3/8	2 3/8	2.10	4.20
609	16	1 1/8	3/16	2 3/16	2.10	4.20

For Woodruff Keyseat Cutters Arbor Type see page 35.
List continued on page 37

Woodruff Keyseat Cutters—continued

SHANK TYPE

All sizes have uniform shank ½″ diameter.

Keys and cutters correspond in size and number with the exceptions as noted at the bottom of page.

Right Hand Cutters are carried in stock. Left Hand Cutters are special. Prices on application.

Carbon Steel No. W100 — High Speed Steel No. W500

Number of Cutter		Dimensions—Inches			Price Each	
*American Standard	Old Standard	Diameter	Width Face	Length Overall	Carbon Steel	High Speed Steel
807	A	⅞	¼	2¼	$1.70	$3.40
808	15	1	¼	2¼	1.90	3.80
...	17	1⅛	7/32	2 7/32	2.10	4.20
809	18	1⅛	¼	2¼	2.10	4.20
...	19	1¼	3/16	2 3/16	2.30	4.60
...	20	1¼	7/32	2 7/32	2.30	4.60
810	21	1¼	¼	2¼	2.30	4.60
811	22	1⅜	¼	2¼	2.50	5.00
812	24	1½	¼	2¼	2.80	5.50
1008	B	1	5/16	2 5/16	2.00	4.00
1009	C	1⅛	5/16	2 5/16	2.20	4.40
1010	D	1¼	5/16	2 5/16	2.50	4.90
1011	23	1⅜	5/16	2 5/16	2.70	5.40
1012	25	1½	5/16	2 5/16	3.00	5.90
1210	E	1¼	⅜	2⅜	2.50	4.90
1211	F	1⅜	⅜	2⅜	2.70	5.40
1212	G	1½	⅜	2⅜	3.00	5.90

For Key No. 121 Use Cutter No. A or No. 807
For Key No. 141 Use Cutter No. 15 or No. 808
For Key No. 131 Use Cutter No. B or No. 1008
For Key No. 161 Use Cutter No. C or No. 1009

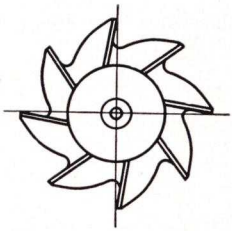
*The cutter number shown under the column headed "American Standard" indicates the nominal key dimension or size cutter, that is, the last two digits give the nominal diameter in 8ths of an inch and the digits preceding the last two give the nominal width in 32nds of an inch. Thus, Cutter No. 204 indicates a size 2/32″ x ⅝″ or 1/16″ thick x ½″ diameter.

Cutter No. 1210 indicates a size ⅜″ thick x 1¼″ diameter.

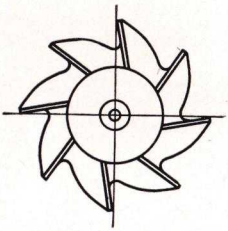
For Woodruff Keyseat Cutters Arbor Type see page 35.

End Mills

SPIRAL CUT



LEFT HAND



RIGHT HAND

End Mills are used for a wide variety of milling operations such as slotting, end milling, profiling and surface milling. Solid Type End Mills ½″ diameter and over are made with deep counterbores to give a much longer resharpening life.

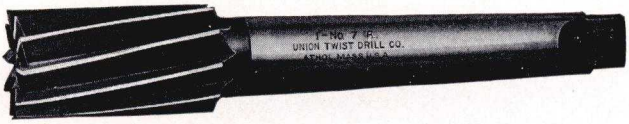
End Mills with Spiral Flutes give a very free cutting action, produce a good finish and last longer than Straight Fluted Mills. We particularly recommend Spiral Fluted Mills for all end milling operations, but we are prepared to furnish Straight Fluted Mills at special prices.

Two Lipped End Mills are designed to sink directly into the metal, eliminating the necessity of drilling. We recommend this type of mill for rapid milling in solid metal. For best results a high surface speed is necessary. These mills are carried in stock with both Straight and Spiral Flutes, of the sizes listed on the following pages.

Nearly all the regular makes of milling machines have spindles provided with Brown and Sharpe taper holes and the collets furnished correspond to this taper. In many cases, however, special collets have been made with the inside taper of Morse standard to accommodate drills and other tools. For the convenience of our customers, we therefore carry a stock of End Mills made with both Brown and Sharpe and Morse taper shanks as listed on the following pages.

Spiral Cut End Mills

BROWN AND SHARPE TAPER SHANKS



These end mills are Standard with either right or left hand cut. Right hand mills have right hand spiral flutes and left hand mills have left hand spiral flutes.

Spiral cut end mills with No. 5 Brown and Sharpe taper shank are regularly furnished without tang.

Spiral cut end mills with No. 9 Brown and Sharpe taper shank are Standard with either tang end or shank tapped for draw-in bolt.

Unless otherwise specified these mills with No. 9 Brown and Sharpe taper shank will be furnished with tang end.

When specified we will furnish at regular prices spiral cut end mills with No. 9 Brown and Sharpe taper shank tapped for draw-in bolt. Tapped hole in shank will be 5/8"-11 N. C. right hand Class 2 fit. Minimum length of full thread 3/4".

Sizes and dimensions not listed are special.

Catalog No.	Dimensions—Inches			No. of B. & S. Taper Shank	Price Each	
	Diameter	Length of Cut	Length Overall		Carbon Steel	High Speed Steel
H51	1/4	5/8	2 13/16	5	$ 1.70	$ 3.30
H53	5/16	11/16	2 7/8	5	1.70	3.30
H55	3/8	3/4	2 15/16	5	1.70	3.30
H57	7/16	7/8	3 1/16	5	1.80	3.50
H58	1/2	15/16	3 1/8	5	1.80	3.50
H59	1/2	15/16	4 15/16	7	2.60	5.10
H61	9/16	1	5	7	2.60	5.10
H63	5/8	1 1/8	5 1/8	7	2.70	5.30
H66	3/4	1 1/4	5 1/4	7	2.70	5.30
H70	7/8	1 7/16	5 7/16	7	3.10	6.10
H74	1	1 5/8	5 5/8	7	3.50	7.00
H79	1 1/8	1 3/4	7	9	4.70	9.30
H83	1 1/4	2	7 1/4	9	5.30	10.50
H87	1 1/2	2 1/4	7 1/2	9	6.70	13.30
H89	1 3/4	2 1/2	7 3/4	9	8.30	16.60
H90	2	2 3/4	8	9	10.50	21.00

For End Mills with Morse Taper Shanks see page 40.
For Straight Shank End Mills see page 41.
For Two Lipped End Mills see pages 42–43.
For Collets see page 276.

Spiral Cut End Mills

MORSE TAPER SHANKS

These end mills are Standard with right hand cut and right hand spiral flutes.

Left hand end mills are special.

Sizes and dimensions not listed are special.

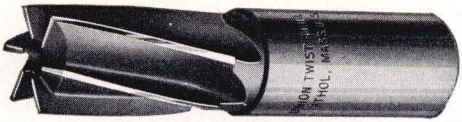
Catalog No.	Dimensions—Inches			No. of Morse Taper Shank	Price Each	
	Diameter	Length of Cut	Length Overall		Carbon Steel	High Speed Steel
H145	1/4	5/8	3 1/2	1	$1.60	$3.20
H146	5/16	11/16	3 9/16	1	1.70	3.30
H147	3/8	3/4	3 5/8	1	1.70	3.30
H148	7/16	7/8	3 3/4	1	1.70	3.30
H150	1/2	15/16	3 15/16	1	1.70	3.40
H151	1/2	15/16	4 7/16	2	2.40	4.80
H154	5/8	1 1/8	4 5/8	2	2.50	4.90
H156	3/4	1 1/4	4 3/4	2	2.50	4.90
H157	3/4	1 1/4	5 9/16	3	3.50	7.00
H160	7/8	1 7/16	4 15/16	2	2.90	5.70
H161	7/8	1 7/16	5 3/4	3	3.50	7.00
H164	1	1 5/8	5 1/8	2	3.30	6.60
H165	1	1 5/8	5 15/16	3	3.70	7.30
H168	1 1/8	1 3/4	6 1/16	3	4.20	8.40
H170	1 1/4	2	6 5/16	3	4.80	9.60

For End Mills with Brown and Sharpe Taper Shanks see page 39.

For Straight Shank End Mills see page 41.

For Two-Lipped End Mills see pages 42–43.

Straight Shank End Mills



These end mills are Standard with either right or left hand cut.

The diameter of shank is the same as the diameter of cut.

Straight shank end mills under 1/4″ diameter have straight flutes. Sizes 1/4″ diameter and over, right hand mills have right hand spiral flutes and left hand mills have left hand spiral flutes.

Sizes and dimensions not listed are special.

Catalog No.	Dimensions—Inches			Price Each	
	Diameter	Length of Cut	Length Overall	Carbon Steel	High Speed Steel
H350	1/8	5/16	1 1/4	$0.70	$1.40
H351	5/32	5/16	1 1/4	.80	1.50
H352	3/16	1/2	1 3/8	.90	1.70
H353	7/32	9/16	1 5/8	.90	1.80
H354	1/4	5/8	1 11/16	.90	1.80
H356	5/16	11/16	1 3/4	1.00	1.90
H358	3/8	3/4	1 13/16	1.10	2.10
H360	7/16	7/8	2 3/16	1.20	2.30
H361	1/2	15/16	2 1/4	1.30	2.50
H362	9/16	1	2 5/16	1.40	2.70
H363	5/8	1 1/8	2 1/2	1.50	3.00
H365	3/4	1 1/4	2 5/8	1.80	3.50

For End Mills with Brown and Sharpe Taper Shanks see page 39.

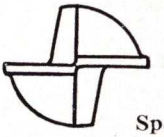
For End Mills with Morse Taper Shanks see page 40.

For Two-Lipped End Mills see pages 42–43.

Two-Lipped End Mills

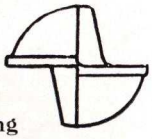
WITH BROWN AND SHARPE TAPER SHANKS

HIGH SPEED STEEL



Left Hand

Right Hand



Specify Right or Left Hand in ordering

These end mills are Standard in high speed steel only, with either right or left hand cut, straight or spiral flutes.

Right hand mills have right hand spiral flutes and left hand mills have left hand spiral flutes.

Two-lipped end mills with No. 5 Brown and Sharpe taper shank are regularly furnished without tang.

Two-lipped end mills with No. 9 Brown and Sharpe taper shank are Standard with either tang end or shank tapped for draw-in bolt.

Unless otherwise specified these mills with No. 9 Brown and Sharpe taper shank will be furnished with tang end.

When specified we will furnish at regular prices two-lipped end mills with No. 9 Brown and Sharpe taper shank tapped for draw-in bolt. Tapped hole in shank will be 5/8"-11 N. C. right hand Class 2 fit. Minimum length of full thread 3/4".

These mills can be furnished with Morse Taper Shanks at special prices.

Catalog No.		Dimensions—Inches			No. of B. & S. Taper Shank	Price Each High Speed Steel
Straight Flute	Spiral Flute	Diameter	Length of Cut	Length Overall		
H301	H401	1/4	3/8	2 9/16	5	$ 3.40
H302	H402	1/4	3/8	4 3/8	7	5.30
H303	H403	5/16	15/32	2 21/32	5	3.40
H304	H404	5/16	15/32	4 15/32	7	5.30
H305	H406	3/8	9/16	4 9/16	7	5.40
H306	H408	7/16	21/32	4 21/32	7	5.40
H307	H409	1/2	3/4	4 3/4	7	5.40
H309	H411	5/8	15/16	4 15/16	7	5.60
H311	H413	3/4	1 1/8	5 1/8	7	5.80
H315	H415	7/8	1 5/16	5 5/16	7	6.70
H318	H417	1	1 1/2	6 3/4	9	9.90
H322	H419	1 1/4	1 7/8	7 1/8	9	11.60
H326	H420	1 1/2	2 1/4	7 1/2	9	14.60

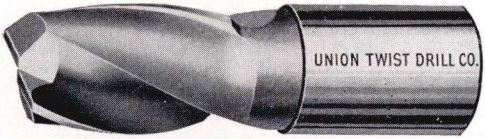
Carbon Steel Two-Lipped End Mills are special. Prices on application.
For Two-Lipped End Mills with straight shanks see page 43.
For Collets see page 276.

Two-Lipped End Mills

WITH STRAIGHT SHANKS

HIGH SPEED STEEL

STRAIGHT FLUTE



SPIRAL FLUTE

Specify Right or Left Hand in ordering

These end mills are Standard in high speed steel only, with either right or left hand cut, straight or spiral flutes.

Right hand mills have right hand spiral flutes and left hand mills have left hand spiral flutes.

The diameter of the shank is the same as the diameter of cut.

Catalog No.		Dimensions—Inches			Price Each High Speed Steel
Straight Flute	Spiral Flute	Diameter	Length of Cut	Length Overall	
H204	H374	1/4	3/8	1 7/16	$1.90
H206	H376	5/16	15/32	1 9/16	2.10
H207	H377	3/8	9/16	1 5/8	2.20
H208	H378	7/16	21/32	2	2.40
H209	H379	1/2	3/4	2 1/16	2.80
H211	H381	5/8	15/16	2 5/16	3.30
H212	H382	3/4	1 1/8	2 1/2	3.60

Carbon Steel Two-Lipped End Mills are special. Prices on application.

For Two-Lipped End Mills with taper shanks see page 42.

Helical End Mills

Helical End Mills have sharp spiral undercut teeth giving a very smooth shearing action. These Mills cut on the side only, and are not recommended for end cutting. This type of End Mill is especially adapted for valve bushing port holes, also for cam track milling.

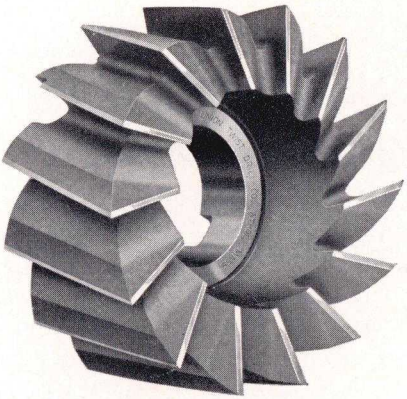
We are prepared to furnish these Mills either Carbon or High Speed Steel in sizes ¼″ diameter and larger. Prices on application.

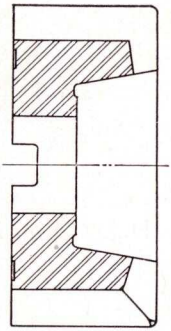
Unless otherwise specified we will furnish these Mills Right Hand Cut Right Hand Spiral.

Shell End Mills

NATIONAL STANDARD

HIGH SPEED STEEL





Shell End Mills have undercut hooked type teeth. The depth of counterbore and strong teeth make recutting possible.

These end mills conform to the National Standard dimensions adopted by the Simplified Practice Committee on Milling Cutters.

Shell End Mills carried in stock have spiral flutes, and are either right or left hand cut. Right hand mills have right hand spiral flutes and left hand mills have left hand spiral flutes.

In ordering specify hand required.

Unless otherwise specified these Mills will be furnished with chamfered corners. Mills with sharp corners or round corners with 1/8″ radius can be furnished at regular prices if desired.

Catalog No.	Dimensions—Inches			Size of Driving Slot—Inches		Price Each High Speed Steel
	Diam.	Length of Cut	Size Hole	Width	Depth	
NL697	1 1/4	1	1/2	1/4	5/32	$ 5.40
NL698	1 1/2	1 1/8	1/2	1/4	5/32	6.00
NL699	1 3/4	1 1/4	3/4	5/16	3/16	6.70
NL700	2	1 3/8	3/4	5/16	3/16	7.70
NL701	2 1/4	1 1/2	1	3/8	7/32	9.00
NL702	2 1/2	1 5/8	1	3/8	7/32	10.70
NL703	2 3/4	1 5/8	1	3/8	7/32	12.10
NL704	3	1 3/4	1 1/4	1/2	9/32	14.20
NL706	3 1/2	1 7/8	1 1/4	1/2	9/32	19.20
NL708	4	2 1/4	1 1/2	5/8	3/8	25.50
NL709	4 1/2	2 1/4	1 1/2	5/8	3/8	30.80
NL710	5	2 1/4	1 1/2	5/8	3/8	36.70
NL711	5 1/2	2 1/4	2	3/4	7/16	42.10
NL712	6	2 1/4	2	3/4	7/16	50.20

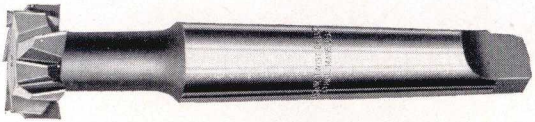
Carbon Steel Shell End Mills are special. Prices on application.

For Shell End Mill Arbors see pages 267–268.
For Shell End Mills with Inserted Blades see page 140.

T Slot Cutters

WITH BROWN AND SHARPE TAPER SHANKS

HIGH SPEED STEEL



T Slot Cutters have staggered teeth, undercut, with side chip clearance and conform to the new standard dimensions adopted by the Simplified Practice Committee on Milling Cutters. These cutters with No. 5 Brown and Sharpe taper shank are regularly furnished without tang.

T Slot Cutters are carried in stock either right or left hand. In ordering specify hand required.

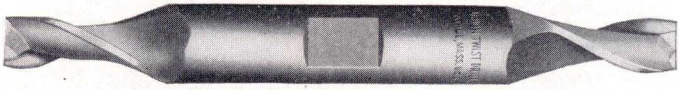
Catalog No.	No. of Cutter	Dimensions—Inches					No. of B. & S. Taper Shank	Price Each High Speed Steel
		Bolt Size	Diam. of Cutter	Thickness of Cutter	Diam. of Neck	Length Overall		
T50	1	1/4	9/16	15/64	17/64	2 5/8	5	$ 6.20
T51	2	5/16	21/32	17/64	21/64	2 23/32	5	6.60
T52	3	3/8	25/32	21/64	13/32	4 13/16	7	11.40
T53	4	1/2	31/32	25/64	17/32	5	7	12.60
T54	5	5/8	1 1/4	31/64	21/32	5 1/4	7	16.40
T55	6	3/4	1 15/32	5/8	25/32	6 7/8	9	18.90
T56	7	1	1 27/32	53/64	1 1/32	7 1/4	9	29.00
T57	8	1 1/4	2 7/32	1 3/32	1 9/32	7 13/16	9	37.50
T58	9	1 1/2	2 21/32	1 11/32	1 17/32	10 3/8	10	60.10

Carbon Steel T Slot Cutters are special. Prices on application.

For Collets see page 276.

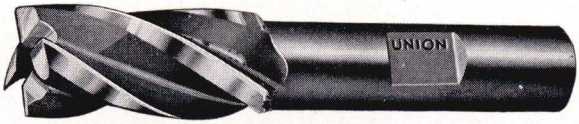
Double-End End Mills

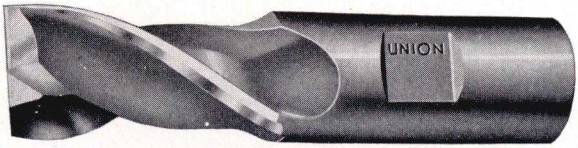
HIGH SPEED STEEL



Single-End End Mills

HIGH SPEED STEEL



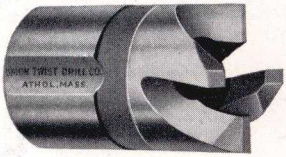


Pamphlet showing standard sizes and list prices will be mailed upon request.

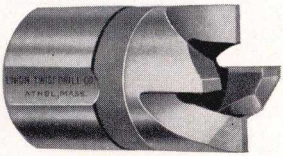
Hollow Mills

With Three or Four Teeth

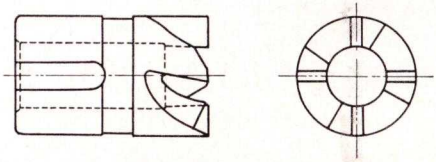
CARBON AND HIGH SPEED STEEL



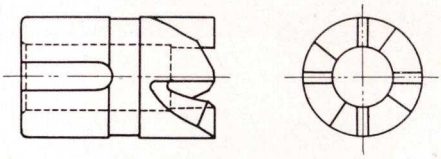
FOUR TEETH UNDERCUT FOR STEEL



FOUR TEETH STRAIGHT FOR BRASS



Four Teeth, Undercut, for Steel



Four Teeth, Straight, for Brass

These mills are used principally in Screw Machines for sizing material such as studs, screw blanks, etc., made from the bar on production work. They are made with two forms of teeth—one undercut for milling steel and one straight for milling brass.

They can be furnished with three teeth or four teeth, Carbon or High Speed Steel.

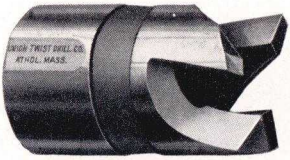
For sizes carried in stock, also list prices see page 49.

Continued on page 49

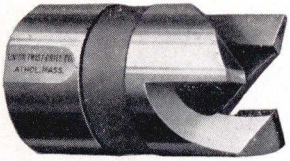
Hollow Mills—continued

With Three or Four Teeth

CARBON AND HIGH SPEED STEEL



THREE TEETH
UNDERCUT
FOR STEEL



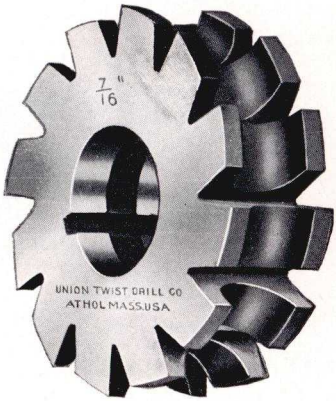
THREE TEETH
STRAIGHT
FOR BRASS

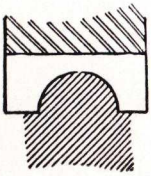
These Mills are made with two forms of teeth, one undercut for milling steel, and one straight for milling brass, with either three or four teeth, Carbon or High Speed Steel. Specify which is required.

Catalog No.	Dimensions—Inches			Price Each	
	Diameter		Length Overall	Carbon Steel	High Speed Steel
	Hole	Shank			
K50	3/32	5/8	1 1/2	$1.35	$3.60
K51	1/8	5/8	1 1/2	1.35	3.60
K52	5/32	5/8	1 1/2	1.35	3.60
K53	3/16	5/8	1 1/2	1.35	3.60
K54	7/32	5/8	1 1/2	1.35	3.60
K55	1/4	5/8	1 1/2	1.35	3.60
K56	9/32	3/4	1 1/2	2.00	3.90
K57	5/16	3/4	1 1/2	2.00	3.90
K58	11/32	3/4	1 1/2	2.00	3.90
K59	3/8	1	1 3/4	2.70	4.25
K60	7/16	1	1 3/4	2.70	4.25
K61	1/2	1	1 3/4	2.70	4.25
K62	9/16	1 1/4	2	3.00	5.55
K63	5/8	1 1/4	2	3.00	5.55
K64	11/16	1 1/2	2	3.35	6.85
K65	3/4	1 1/2	2	3.35	6.85
K66	13/16	1 1/2	2	3.35	6.85
K67	7/8	1 3/4	2 1/4	4.00	8.45
K68	15/16	1 3/4	2 1/4	4.00	8.45
K69	1	1 3/4	2 1/4	4.00	8.45

See page 48 for line drawings and other information.

Concave Cutters



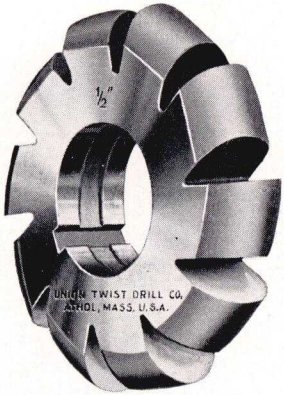


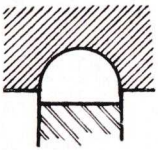
Concave Cutters have formed teeth and can be sharpened by grinding without changing their form. These cutters are designed for milling half circles.

Catalog No.	Dimensions—Inches			Price Each	
	Diam. of Circle	Diam. of Cutter	Size Hole	Carbon Steel	High Speed Steel
D1	1/8	2	7/8	$3.10	$ 6.20
D2	3/16	2	7/8	3.40	6.80
D3	1/4	2	7/8	3.50	7.00
D4	5/16	2 1/4	7/8	4.30	8.50
D5	3/8	2 1/4	7/8	4.30	8.50
D6	7/16	2 1/4	7/8	4.50	9.00
D7	1/2	2 1/4	7/8	4.80	9.50
D8	5/8	2 3/4	1	6.10	12.10
D9	3/4	3	1	7.40	14.70
D10	7/8	3 1/4	1	8.50	16.90
D11	1	3 1/4	1	9.20	18.40

For Convex Cutters, see page 51.
For Grinding Gauge, see page 278.
For Grinding Machine and Fixtures, see pages 288–289, 297.
For Keyway, see page 8.

Convex Cutters





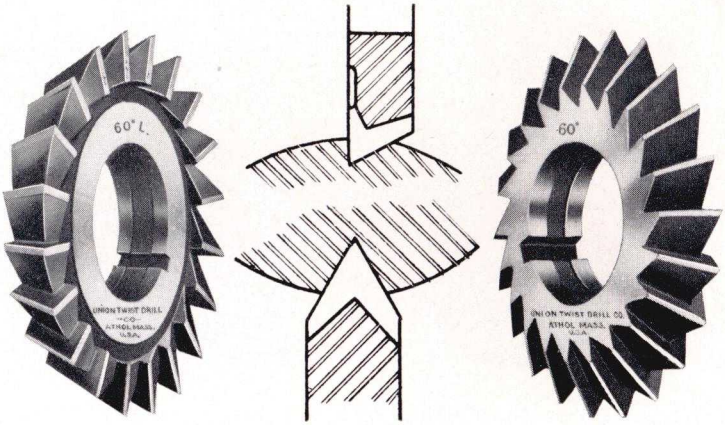
Convex Cutters have formed teeth and can be sharpened by grinding without changing their form. These cutters are designed for milling half circles.

Catalog No.	Dimensions—Inches			Price Each	
	Diam. of Circle	Diam. of Cutter	Size Hole	Carbon Steel	High Speed Steel
D20	1/8	2	7/8	$3.00	$ 6.00
D21	3/16	2	7/8	3.00	6.00
D22	1/4	2	7/8	3.10	6.20
D23	5/16	2 1/4	7/8	3.60	7.20
D24	3/8	2 1/4	7/8	3.80	7.50
D25	7/16	2 1/4	7/8	3.90	7.80
D26	1/2	2 1/4	7/8	4.10	8.10
D27	5/8	2 3/4	1	5.20	10.40
D28	3/4	3	1	6.00	12.00
D29	7/8	3 1/4	1	7.00	13.90
D30	1	3 1/4	1	7.30	14.60

For Concave Cutters see page 50.
For Grinding Gauge see page 278.
For Grinding Machine and Fixtures see pages 288–289, 297.
For Keyway see page 8.

Angle Milling Cutters

SINGLE AND DOUBLE



Single Angle **Double Angle**

Angle Milling Cutters are adapted for cutting the teeth of ratchet wheels, cutters and mills.

Single Angle Cutters are carried in stock either right or left hand with included angle of 45° or 60°.

Double Angle Cutters are carried in stock with an included angle of either 45°, 60° or 90°, the angle being equal on each side of the center line.

In ordering give diameter and included angle, also state whether right or left hand cutter is required.

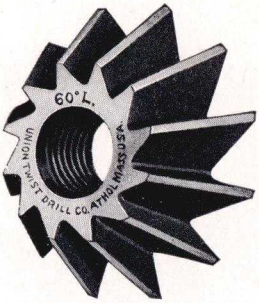
Catalog No. Single Angle	Catalog No. Double Angle	Dimensions—Inches			Price Each	
		Diameter	Width Face	Size Hole	Carbon Steel	High Speed Steel
F5	...	2½	½	⅞	$3.30	$6.60
F6	F11	2¾	½	1	3.60	7.20
F7	...	3	½	1¼	4.00	8.00

For Angle Milling Cutters with threaded holes see page 53.

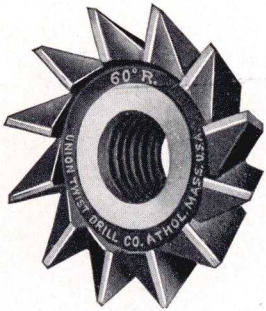
For Grinding Machine see pages 290–291.

For Keyway see page 8.

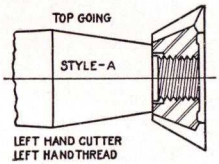
Angle Milling Cutters with Threaded Holes

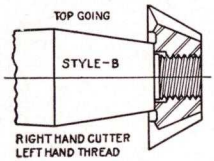


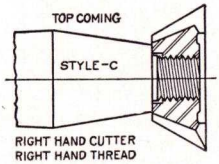
Left Hand Cutter
Left Hand Angle

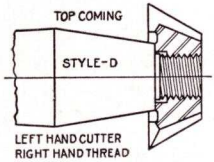


Right Hand Cutter
Right Hand Angle









Angle Milling Cutters with threaded holes are for dove tail slots and similar work where it is not possible to use a nut on the end of the arbor to hold cutter.

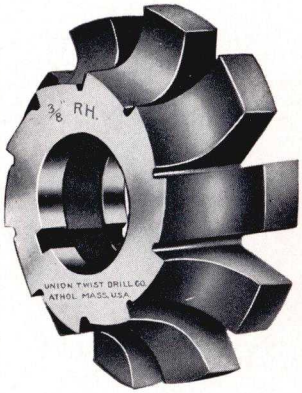
These cutters are carried in stock either right or left hand and with either right or left hand thread. They have an included angle of 60°.

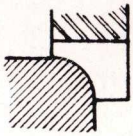
In ordering give angle and style of cutter required.

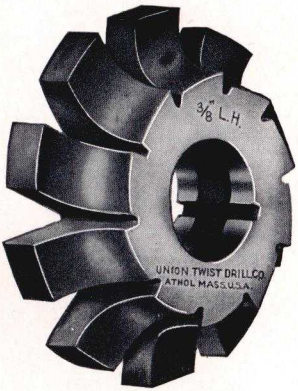
Catalog No.	Dimensions—Inches			Price Each	
	Diameter	Width Face	Size Hole	Carbon Steel	High Speed Steel
F20	1 1/4	7/16	3/8-24NF	$2.70	$5.40
F21	1 5/8	9/16	1/2-20NF	3.10	6.10

For single and double Angle Milling Cutters see page 52.
For Milling Machine Screw Arbors see page 269.
For Grinding Machine see pages 290–291.

Corner Rounding Cutters







Right Hand Single **Left Hand Single**

Corner Rounding Cutters have formed teeth with side and radial clearance, and can be sharpened by grinding without changing their form.

These Cutters are carried in stock, either right or left hand. In ordering specify hand required.

RIGHT HAND SINGLE

Catalog No. Right Hand Cutter	Dimensions—Inches			Price Each	
	Radius of Circle	Diam. of Cutter	Size Hole	Carbon Steel	High Speed Steel
D63	1/8	2	7/8	$3.10	$ 6.20
D67	1/4	2 1/4	7/8	3.90	7.80
D69	3/8	3	1	5.70	11.30
D71	1/2	3 1/4	1	6.60	13.10
D73	5/8	3 1/2	1	8.00	16.00

LEFT HAND SINGLE

Catalog No. Left Hand Cutter	Dimensions—Inches			Price Each	
	Radius of Circle	Diam. of Cutter	Size Hole	Carbon Steel	High Speed Steel
D43	1/8	2	7/8	$3.10	$ 6.20
D47	1/4	2 1/4	7/8	3.90	7.80
D49	3/8	3	1	5.70	11.30
D51	1/2	3 1/4	1	6.60	13.10
D53	5/8	3 1/2	1	8.00	16.00

Corner Rounding Cutters, right and left hand double are special. Prices on application.

For Grinding Gauge see page 278.
For Grinding Machine and fixtures see pages 288–289, 297.
For Keyway see page 8.

Cutters for Cutting the Teeth of Gears

The oldest Cutter known, as shown in cut, for cutting the teeth of Gears was made by Vaucanson prior to 1782, according to investigations and research. It is difficult to determine if the teeth in this cutter were made by chisel or file, but the cut and data are interesting. Note the hole, it has the appearance of a broached hole. Cutters for different pitches were later developed but had the same general type of profile teeth. We refer to this as the old type of Gear Cutter.

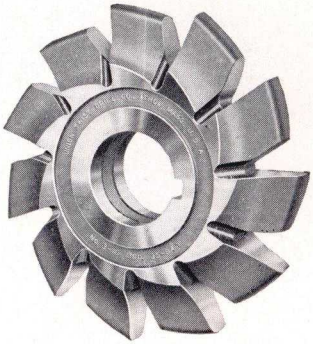
> Development of Involute Gear Cutters for Cutting the Teeth of Gear Wheels which are sharpened by grinding the face of tooth without changing its form.

The old type of Gear Cutter with fine pitch of teeth was in general use up to displacement by the formed type.

Continued on page 56

Cutters for Cutting the Teeth of Gears—continued

The old cutters were difficult to produce, with profile type of teeth, and difficult to keep sharp. When dull they were either annealed and recut or touched up with a stone or file. Due to hardening and mechanical difficulties they did not maintain the desired accuracy.



This type was gradually displaced by the formed type, as shown, which was patented in 1864, and carried the involute or single curve shape for Gears as used at that time. This formed Gear Cutter is sharpened when dull by grinding on the face of tooth, thus preserving the shape of the cut or path during the life of cutter.

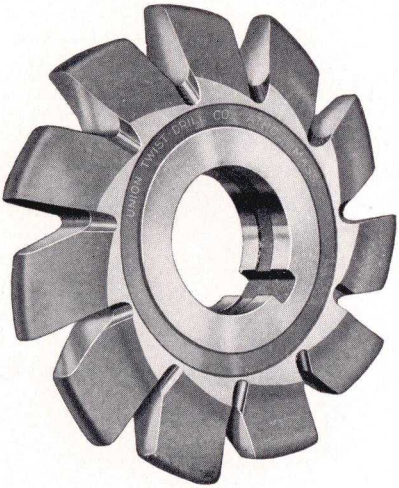
With the finer requirements of machine shop practice a more practical or desirable curve for gear teeth was required, which resulted in the development of the double curve or epicycloidal form. Continuing the development of a more satisfactory curve, long experiments were made which finally developed the involute curve of the present time, which is, generally speaking, a compromise between the old involute or single curve and the epicycloidal or double curve, and is accepted as practice for general purposes.

Continued on page 57

Cutters for Cutting the Teeth of Gears—continued

It is our practice to make all cutters to original forms, that is, if the forming tool is used up a new tool is made from the original master tool and not from the worn out tool.

Form Ground Gear Cutters



Cutters made with the usual limits of accuracy are satisfactory for general purposes, but there are cases where closer tolerances are required.

We are prepared to furnish Gear Cutters, ground to shape, removing all distortion due to hardening and within extremely close limits. Results obtained from the use of Ground Cutters are most satisfactory.

Other Formed Cutters of similar construction may be ground as above.

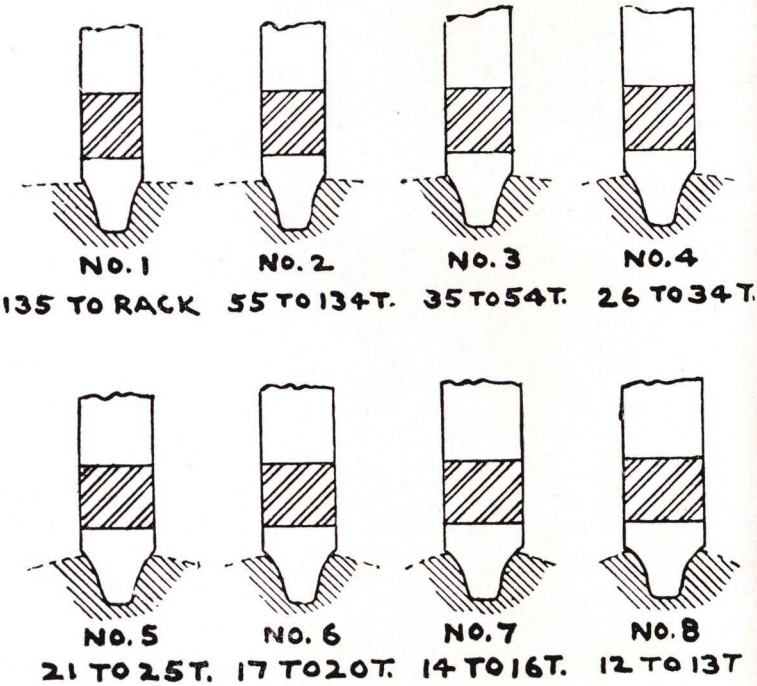
Comparative Curves of Involute Tooth Shapes

The diagram below will illustrate how the curves vary in the eight different cutters necessary to make a complete set of one pitch.

It will be noticed that there is a gradual increase in the curve of the tooth outline from the No. 1 to the No. 8 cutter, which will make it clear that one cutter cannot be suitable for cutting all sizes of gears.

It has been found by experiment that the set of 8 cutters will cut gears from 12 teeth to a rack and give very good results, but a cutter should never be used for any gear other than those included in the range which it is designed to cut.

All gears of the same pitch cut with these cutters will be interchangeable.



The above cutters represent 8 Diametral Pitch.

Involute Gear Cutters

RANGE OF CUTTERS

According to the system adopted by us eight cutters are required for each pitch. These eight cutters are adapted to cut from a pinion of twelve teeth to a rack, and are numbered respectively as follows:

No. 1 will cut wheels from 135 teeth to a rack.
No. 2 will cut wheels from 55 teeth to 134 teeth.
No. 3 will cut wheels from 35 teeth to 54 teeth.
No. 4 will cut wheels from 26 teeth to 34 teeth.
No. 5 will cut wheels from 21 teeth to 25 teeth.
No. 6 will cut wheels from 17 teeth to 20 teeth.
No. 7 will cut wheels from 14 teeth to 16 teeth.
No. 8 will cut wheels from 12 teeth to 13 teeth.

HALF NUMBERS

When a finer division of teeth is required, we can furnish cutters made to half numbers.

Gears cut with these cutters will interchange with gears cut with the regular No. 1 to No. 8 cutters, and on account of the smaller range covered, more accurate and better running gears are produced.

The half numbers are as follows:

No. of Cutter	Range	No. of Cutter	Range
1½	80 to 134 teeth	5½	19 to 20 teeth
2½	42 to 54 teeth	6½	15 to 16 teeth
3½	30 to 34 teeth	7½	13 teeth
4½	23 to 25 teeth		

In ordering, give the No. of cutter, diametral pitch, diameter of cutter, and size of hole required. Always state if "Range Cutter or Single Purpose Cutter" for exact number of teeth is wanted. A stock of cutters from 1¾ to 48 pitch is kept on hand.

We are also prepared to furnish to order cutters for pinions of 6, 7, 8, 9, 10 and 11 teeth that will interchange with the regular gears. A separate cutter is required for each pinion.

For Gear Cutters ground on form see page 57.

Gear Cutters for the Exact Number of Teeth

OR

SINGLE PURPOSE CUTTERS

As explained and shown in the preceding tables the regular cutters such as are commonly carried in stock are designed to take in a range of sizes. It will be readily understood that the curve of the tooth form for any particular cutter is fixed and the cutter can therefore be correct for only one size of gear or number of teeth. It is the general practice to make the cutter correct for the lowest number of teeth mentioned in the range which it covers. For instance, a No. 2 cutter which cuts from 55 to 134 teeth is made of the correct curve for 55 teeth. When the cutter is used for any number of teeth greater than 55, the teeth will be rounded over more than is actually necessary. Owing to this feature the length of bearing on the tooth decreases gradually with the increase in the number of teeth in gear, and such gears will not run quite as smoothly and quietly as gears with teeth cut of the correct shape.

For general purposes the stock cutters have proved satisfactory, but there is an increasing demand for gears with teeth cut as nearly as possible to the theoretically correct curve, thus securing a longer bearing and the very best results as regards smooth action and quiet running. Such gears are particularly valuable for use on milling machines, lathes, planers, drills and kindred tools, and have been largely adopted.

We have every facility for producing cutters for such gears made of the correct curve for the exact number of teeth to be cut, and recommend their use as a means of improving the gearing feature of machine tools. These Cutters are called "Single Purpose Cutters."

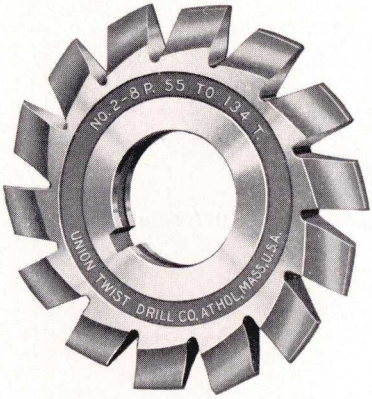
It should be understood that to obtain the full benefit of these cutters, unusual care must be taken in sizing, cutting and mounting the gears.

Prices for cutters quoted promptly on receipt of data as to pitch, number of teeth and sizes required.

Involute Gear Cutters

FOR TEETH OF GEAR WHEELS

All Gears Of The Same Pitch Cut With These Cutters Are Interchangeable



STANDARD KEYWAYS

There are eight cutters numbered 1 to 8 inclusive made for each pitch and are commonly referred to as Range Numbers. These eight cutters are adapted to cut from a pinion of 12 teeth to a rack; see page 59 for Range numbers.

Involute Gear Cutters designed to cut an exact number of teeth are known as Single Purpose Cutters and are made to order. Prices on application.

In ordering, specify No. of cutter or range number, diametral pitch, and size of hole required. If a Single Purpose Cutter is wanted state the exact number of teeth to be cut.

Cutters marked * are not kept in stock, but are made to order. Prices on application.

When required, Form Ground Gear Cutters can be furnished. Prices on application.

Carbon Steel No. R100 — High Speed Steel No. R500

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
*1	8½	2	Prices on application	Prices on Application
*1¼	7¾	2		
*1½	7	1¾		
1¾	6½	1¾	$30.20	$60.40
2	5¾	1½	22.30	44.50
2½	5¾	1½	20.00	40.00
3	4¾	1¼	12.60	25.10
4	4¼	1¼	9.60	19.20
5	3¾	1¼	7.80	15.50

For Gauges see page 278.
For Keyway see page 8.
For Grinding Machine and Fixtures see pages 288–289, 297.
List continued on page 62

Involute Gear Cutters—continued

STANDARD KEYWAYS

Carbon Steel No. R100 — High Speed Steel No. R500

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
6	3 1/8	1	$6.20	$12.30
7	2 7/8	1	5.40	10.70
8	2 7/8	1	5.10	10.20
9	2 3/4	1	4.50	9.00
10	2 3/8	7/8	4.10	8.20
11	2 3/8	7/8	4.00	7.90
12	2 1/4	7/8	3.60	7.20
14	2 1/8	7/8	3.50	6.90
16	2 1/8	7/8	3.50	6.90
18	2	7/8	3.10	6.20
20	2	7/8	3.10	6.20
22	2	7/8	3.10	6.20
24	1 3/4	7/8	3.00	6.00
26	1 3/4	7/8	2.90	5.80
28	1 3/4	7/8	2.90	5.80
30	1 3/4	7/8	2.90	5.80
32	1 3/4	7/8	2.90	5.80
36	1 3/4	7/8	2.90	5.80
40	1 3/4	7/8	2.90	5.80
48	1 3/4	7/8	2.90	5.80

WITH 1 INCH HOLE

Keyway 1/4 x 3/32

Carbon Steel No. R110 — High Speed Steel No. R510

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
4	3 5/8	1	$8.20	$16.40
5	3 3/8	1	7.20	14.30
10	2 3/4	1	4.50	9.00
11	2 5/8	1	4.30	8.60
12	2 5/8	1	4.30	8.60
14	2 1/2	1	3.80	7.60
16	2 1/2	1	3.80	7.60
18	2 3/8	1	3.80	7.60
20	2 3/8	1	3.80	7.60
22	2 1/4	1	3.50	6.90
24	2 1/4	1	3.50	6.90

Eight Cutters made for each pitch see page 59.
For Gauges see page 278.
For Keyway see page 8.
For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 63

Involute Gear Cutters—continued

WITH 1¼ INCH HOLE Keyway 5/16 x 1/8

Carbon Steel No. R120 High Speed Steel No. R520

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
6	3½	1¼	$6.70	$13.40
7	3⅜	1¼	6.30	12.60
8	3¼	1¼	5.60	11.10
9	3⅛	1¼	5.40	10.70
10	3	1¼	4.90	9.80
12	2⅞	1¼	4.70	9.40

WITH 1½ INCH HOLE Keyway 3/8 x 5/32

Carbon Steel No. R130 High Speed Steel No. R530

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
3	5¼	1½	$14.50	$29.00
4	4½	1½	10.40	20.70
5	4¼	1½	9.00	18.00
6	3⅞	1½	7.90	15.70
7	3⅝	1½	6.80	13.50
8	3½	1½	6.10	12.10

WITH 1¾ INCH HOLE Keyway 7/16 x 3/16

Carbon Steel No. R140 High Speed Steel No. R540

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
2	6½	1¾	$26.30	$52.60
2½	6⅛	1¾	23.70	47.30
3	5⅝	1¾	17.80	35.50
4	4¾	1¾	11.10	22.20
5	4⅜	1¾	9.70	19.40
6	4¼	1¾	8.40	16.80

Eight Cutters made for each pitch see page 59.
For Gauges see page 278.
For Grinding Machine and Fixtures see pages 288–289, 297.

Stocking Cutters for Involute Gears

Stocking Cutters are designed to rough out the teeth in gears, reducing the amount of metal to be removed by the finishing cutter.

We are prepared to furnish several styles of Stocking Cutters best adapted for roughing out gears, including Stepped Tooth, Alternate Plain and Stepped Tooth, and Plain Tooth Cutters as illustrated on pages 66–67.

Styles A, B, and C are carried in stock. Style D is made to order. Prices on application.

Cutters marked * are not carried in stock but are made to order. Prices on application.

In ordering specify diametral pitch, size of hole, and style required.

Carbon Steel No. R310 — High Speed Steel No. R710

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
*1	8½	2	Prices on application	Prices on application
*1¼	7¾	2		
*1½	7	1¾		
1¾	6½	1¾	30.20	60.40
2	5¾	1½	22.30	44.50
2½	5¾	1½	20.00	40.00
3	4¾	1¼	12.60	25.10
4	4¼	1¼	9.60	19.20
5	3¾	1¼	7.80	15.50
6	3⅛	1	6.20	12.30
7	2⅞	1	5.40	10.70
8	2⅞	1	5.10	10.20

For Gauges see page 278.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 65

Stocking Cutters for Involute Gears—continued

In ordering specify diametral pitch, size of hole, and style required. See pages 66–67.

WITH 1 INCH HOLE — Keyway 1/4 x 3/32

Carbon Steel No. R330 — High Speed Steel No. R730

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
4	3 5/8	1	$8.20	$16.40
5	3 3/8	1	7.20	14.30

WITH 1 1/4 INCH HOLE — Keyway 5/16 x 1/8

Carbon Steel No. R350 — High Speed Steel No. R750

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
6	3 1/2	1 1/4	$6.70	$13.40
7	3 3/8	1 1/4	6.30	12.60
8	3 1/4	1 1/4	5.60	11.10

WITH 1 1/2 INCH HOLE — Keyway 3/8 x 5/32

Carbon Steel No. R370 — High Speed Steel No. R770

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
3	5 1/4	1 1/2	$14.50	$29.00
4	4 1/2	1 1/2	10.40	20.70
5	4 1/4	1 1/2	9.00	18.00
6	3 7/8	1 1/2	7.90	15.70

WITH 1 3/4 INCH HOLE — Keyway 7/16 x 3/16

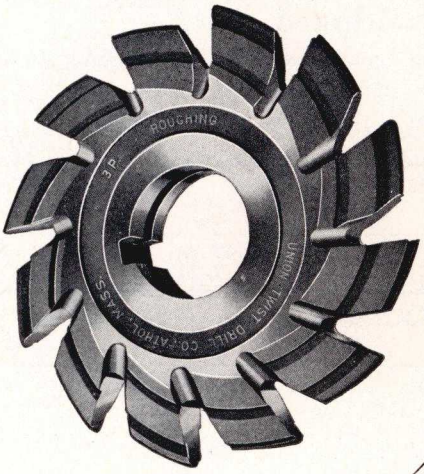
Carbon Steel No. R390 — High Speed Steel No. R790

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
2	6 1/2	1 3/4	$26.30	$52.60
2 1/2	6 1/8	1 3/4	23.70	47.30
3	5 5/8	1 3/4	17.80	35.50
4	4 3/4	1 3/4	11.10	22.20
5	4 3/8	1 3/4	9.70	19.40

For Gauges see page 278.
For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 66

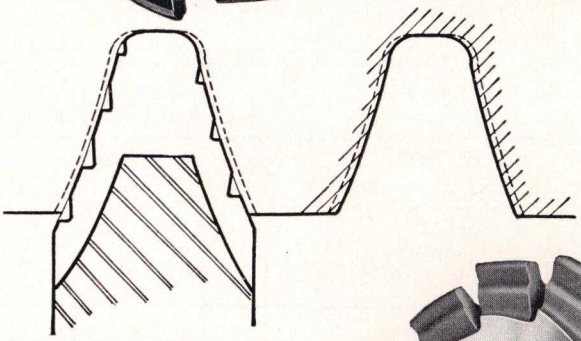
Stocking Cutters for Involute Gears—continued



Roughing Cutters

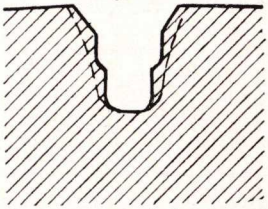
Style A

For sizes carried in stock and list prices, see pages 64–65.

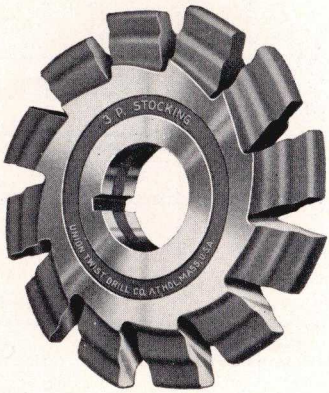


Stocking Cutters

Style B



For sizes carried in stock and list prices, see pages 64–65.



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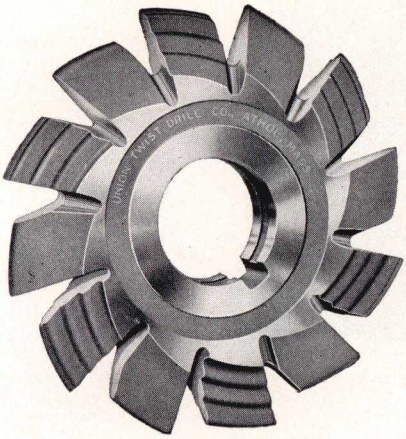
Stocking Cutters for Involute Gears—continued

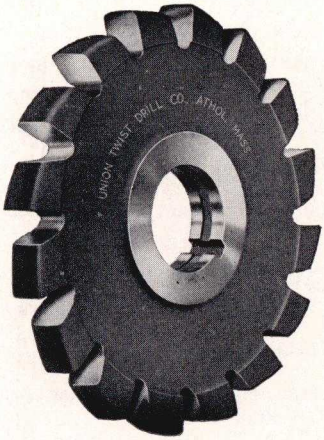


Stocking Cutters

ALTERNATE PLAIN AND STEPPED

Style C

For sizes carried in stock and list prices see pages 64–65.



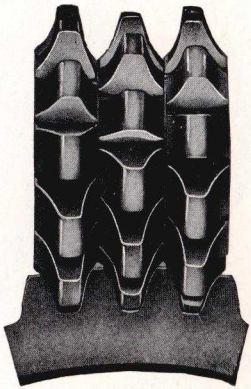
Stocking Cutters

PLAIN

Style D

Made to order. Prices on application.

Radial Duplex Cutters



CARBON OR HIGH SPEED STEEL

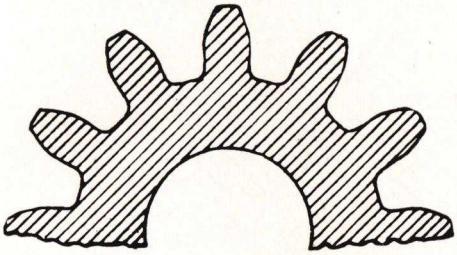
We are prepared to furnish Cutters of this type which many times will effect an economy over the use of the single cutter.

Can be furnished in gangs of two or more; the number of cutters in the gang depending on the number of teeth in gear to be cut. The following will show the number of cutters which may be used in cutting various numbers of teeth:

Under 30 teeth	1 cutter	Over 120 teeth	6 cutters
Over 30 teeth	2 cutters	Over 150 teeth	7 cutters
Over 50 teeth	3 cutters	Over 180 teeth	8 cutters
Over 70 teeth	4 cutters	Over 230 teeth	10 cutters
Over 95 teeth	5 cutters	Over 260 teeth	12 cutters

In ordering give diameter, size of hole and keyway in Cutter. Also pitch and number of teeth in Gear to be cut.

Involute Teeth of Increased Strength



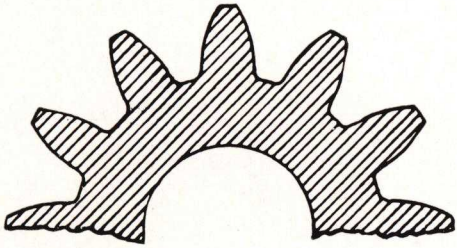
12 TEETH 14½° PRESSURE ANGLE

Mechanics whose labors or studies have been along the line of gearing are familiar with the fact that for a great many years it has been an almost universal custom to make involute gears with a form of tooth designed for 14½° pressure angle. Departures have been made from this rule, however, in individual cases where the demands have been for a stronger tooth. This demand arises more particularly in the case of small pinions having few teeth and which are to perform heavy service. One method of increasing the strength of teeth in such pinions is to adopt gearing of a greater pressure angle. Gears running together must be made according to the same system.

To illustrate the difference we show sketches representing pinions of 12 teeth made to both 14½° and 20° pressure angle. In the pinions of 14½° pressure angle the construction is such that the flanks of the teeth are radial for a certain distance inside the pitch circle. This naturally weakens the tooth, as it is thinner at the root than at the pitch circle, and this feature is more evident the fewer the number of teeth in pinion.

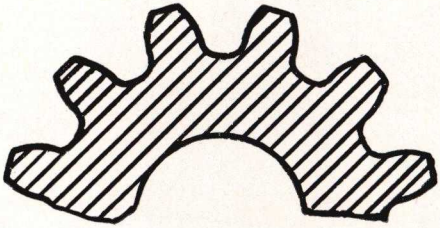
In the pinion of 20° pressure angle it will be noticed that the greater pressure angle gives a tooth of decidedly different outline, and that the root instead of being thinner is wider than the tooth at pitch circle, and consequently stronger than the pinions of 14½° pressure angle.

It is possible to select different pressure angles, although 32° is about the limit if the regular length of tooth is to be maintained. The greater the pressure angle the more V-shaped the tooth, and we think that 20° is perhaps most suitable where sufficient reason exists for making any change. We are prepared to furnish to order special cutters of any pressure angle, and will quote prices on receipt of full information.



12 TEETH 20° PRESSURE ANGLE

Stub Tooth Cutters



12 TEETH 20° PRESSURE ANGLE STUB TOOTH

We are prepared to furnish Cutters of Carbon or High Speed Steel for cutting gears with Stub Teeth.

These cutters are usually made with 20° pressure angle and to cut the different ranges of teeth as given on page 59. They can also be made of exact shape for any given number of teeth.

As a Stub Tooth Gear Cutter of 4-P. is usually made to cut a tooth of the same depth as a regular 5-P. tooth, the cutter is designated as a 4/5-P. Cutter.

The following table gives the tooth dimensions of the most commonly used pitches.

Pitch	Thickness on Pitch Line	Whole Depth of Tooth
4/5	.3925	.4314
5/7	.3140	.3081
6/8	.2617	.2696
7/9	.2243	.2397
8/10	.1962	.2157
9/11	.1744	.1961
10/12	.1570	.1798
12/14	.1308	.1541

The above sketch represents a 12-tooth pinion 6 pitch, 8 pitch depth, 20° pressure angle.

In ordering we should know pressure angle, pitch, and number of teeth to be cut. Also, state if range cutter or "Single Purpose Cutter" for a given number of teeth is wanted, see pages 59–60.

Table

SHOWING THE CORRESPONDING DIAMETRAL AND CIRCULAR PITCHES

Diametral pitch is the number of teeth to each inch of the pitch diameter.

Circular pitch is the distance from the center of one tooth to the center of the next tooth measured along the pitch circle.

No. 1 Table shows the diametral pitches with corresponding circular pitches and depth to be cut in gear.

No. 2 Table shows circular pitches with the corresponding diametral pitches and depth to be cut in gear.

TABLE No. 1			TABLE No. 2		
Diametral Pitch	Circular Pitch, Inches	Depth to be Cut in Gear, Inches	Circular Pitch, Inches	Diametral Pitch	Depth to be Cut in Gear, Inches
1/2	6.2832	4.3142	4	0.7854	2.7464
3/4	4.1888	2.8761	3 1/2	0.8976	2.4031
1	3.1416	2.1571	3	1.0472	2.0598
1 1/4	2.5133	1.7257	2 3/4	1.1424	1.8881
1 1/2	2.0944	1.4381	2 1/2	1.2566	1.7165
1 3/4	1.7952	1.2326	2 1/4	1.3963	1.5448
2	1.5708	1.0785	2	1.5708	1.3732
2 1/4	1.3963	0.9587	1 7/8	1.6755	1.2874
2 1/2	1.2566	0.8628	1 3/4	1.7952	1.2016
2 3/4	1.1424	0.7844	1 5/8	1.9333	1.1158
3	1.0472	0.7190	1 1/2	2.0944	1.0299
3 1/2	0.8976	0.6163	1 7/16	2.1855	0.9870
4	0.7854	0.5393	1 3/8	2.2848	0.9441
5	0.6283	0.4314	1 5/16	2.3936	0.9012
6	0.5236	0.3595	1 1/4	2.5133	0.8583
7	0.4488	0.3081	1 3/16	2.6456	0.8154
8	0.3927	0.2696	1 1/8	2.7925	0.7724
9	0.3491	0.2397	1 1/16	2.9568	0.7295
10	0.3142	0.2157	1	3.1416	0.6866
11	0.2856	0.1961	15/16	3.3510	0.6437
12	0.2618	0.1798	7/8	3.5904	0.6007
14	0.2244	0.1541	13/16	3.8666	0.5579
16	0.1963	0.1348	3/4	4.1888	0.5150
18	0.1745	0.1198	11/16	4.5696	0.4720
20	0.1571	0.1709	5/8	5.0265	0.4291
22	0.1428	0.0980	9/16	5.5851	0.3862
24	0.1309	0.0898	1/2	6.2832	0.3433
26	0.1208	0.0829	7/16	7.1808	0.3003
28	0.1122	0.0770	3/8	8.3776	0.2575
30	0.1047	0.0719	5/16	10.0531	0.2146
32	0.0982	0.0674	1/4	12.5664	0.1716
36	0.0873	0.0599	3/16	16.7552	0.1287
40	0.0785	0.0539	1/8	25.1327	0.0858
48	0.0654	0.0449	1/16	50.2655	0.0429

According to our system any wheel of one pitch will gear into any other wheel or into a rack of the same pitch. Eight Cutters are required for each pitch. These eight Cutters are adapted to cut from a pinion of twelve teeth to a rack, and are numbered respectively 1, 2, 3, etc. The number of teeth and the pitch for which a cutter is adapted are also marked on each. See page 59.

Table

SHOWING CHORDAL THICKNESS AND CORRECTED ADDENDUM FOR MEASURING GEAR TEETH OF 1 D. P.

To accurately measure gear teeth it is necessary to use the chordal thickness and corrected addendum of the tooth.

For other diametral pitches, divide the figures by the pitch required.

No. of Teeth	Chordal Thick.	Cor'cted Ad'ndum	No. of Teeth	Chordal Thick.	Cor'cted Ad'ndum	No. of Teeth	Chordal Thick.	Cor'cted Ad'ndum
						94	1.5707	1.0066
6	1.5529	1.1022	50	1.5705	1.0123	95	1.5707	1.0065
7	1.5568	1.0873	51	1.5706	1.0121	96	1.5707	1.0064
8	1.5607	1.0769	52	1.5706	1.0119	97	1.5707	1.0064
9	1.5628	1.0684	53	1.5706	1.0117	98	1.5707	1.0063
10	1.5643	1.0616	54	1.5706	1.0114	99	1.5707	1.0062
11	1.5654	1.0559	55	1.5706	1.0112	100	1.5707	1.0061
12	1.5663	1.0514	56	1.5706	1.0110	101	1.5707	1.0061
13	1.5670	1.0474	57	1.5706	1.0108	102	1.5707	1.0060
14	1.5675	1.0440	58	1.5706	1.0106	103	1.5707	1.0060
15	1.5679	1.0411	59	1.5706	1.0105	104	1.5707	1.0059
16	1.5683	1.0385	60	1.5706	1.0102	105	1.5707	1.0059
17	1.5686	1.0362	61	1.5706	1.0101	106	1.5707	1.0058
18	1.5688	1.0342	62	1.5706	1.0100	107	1.5707	1.0058
19	1.5690	1.0324	63	1.5706	1.0098	108	1.5707	1.0057
20	1.5692	1.0308	64	1.5706	1.0097	109	1.5707	1.0057
21	1.5694	1.0294	65	1.5706	1.0095	110	1.5707	1.0056
22	1.5695	1.0281	66	1.5706	1.0094	111	1.5707	1.0056
23	1.5696	1.0268	67	1.5606	1.0092	112	1.5707	1.0055
24	1.5697	1.0257	68	1.5706	1.0091	113	1.5707	1.0055
25	1.5698	1.0247	69	1.5707	1.0090	114	1.5707	1.0054
26	1.5698	1.0237	70	1.5707	1.0088	115	1.5707	1.0054
27	1.5699	1.0228	71	1.5707	1.0087	116	1.5707	1.0053
28	1.5700	1.0220	72	1.5707	1.0086	117	1.5707	1.0053
29	1.5700	1.0213	73	1.5707	1.0085	118	1.5707	1.0053
30	1.5701	1.0208	74	1.5707	1.0084	119	1.5707	1.0052
31	1.5701	1.0199	75	1.5707	1.0083	120	1.5707	1.0052
32	1.5702	1.0193	76	1.5707	1.0081	121	1.5707	1.0051
33	1.5702	1.0187	77	1.5707	1.0080	122	1.5707	1.0051
34	1.5702	1.0181	78	1.5707	1.0079	123	1.5707	1.0050
35	1.5702	1.0176	79	1.5707	1.0078	124	1.5707	1.0050
36	1.5703	1.0171	80	1.5707	1.0077	125	1.5707	1.0049
37	1.5703	1.0167	81	1.5707	1.0076	126	1.5707	1.0049
38	1.5703	1.0162	82	1.5707	1.0075	127	1.5707	1.0049
39	1.5704	1.0158	83	1.5707	1.0074	128	1.5707	1.0048
40	1.5704	1.0154	84	1.5707	1.0074	129	1.5707	1.0048
41	1.5704	1.0150	85	1.5707	1.0073	130	1.5707	1.0047
42	1.5704	1.0147	86	1.5707	1.0072	131	1.5708	1.0047
43	1.5705	1.0143	87	1.5707	1.0071	132	1.5708	1.0047
44	1.5705	1.0140	88	1.5707	1.0070	133	1.5708	1.0047
45	1.5705	1.0137	89	1.5707	1.0069	134	1.5708	1.0046
46	1.5705	1.0134	90	1.5707	1.0068	135	1.5708	1.0046
47	1.5705	1.0131	91	1.5707	1.0068	150	1.5708	1.0045
48	1.5705	1.0129	92	1.5707	1.0067	250	1.5708	1.0025
49	1.5705	1.0126	93	1.5707	1.0067	Rack	1.5708	1.0000

Formulas

FOR DETERMINING THE DIMENSIONS OF GEARS BY DIAMETRAL PITCH

Let P denote the *diametral pitch*, or the number of teeth to one inch of diameter of pitch circle.

Let D′ denote the diameter of pitch circle.	*Larger Wheel*	These wheels run together
Let D denote the whole diameter.		
Let N denote the number of teeth.		
Let V denote the velocity.		
Let d′ denote the diameter of pitch circle.	*Smaller Wheel*	
Let d denote the whole diameter.		
Let n denote the number of teeth.		
Let v denote the velocity.		

Let a denote the distance between the centers of the two wheels.

Let b denote the number of teeth in both wheels.

Let t denote the thickness of tooth or cutter on pitch circle.

Let D″ denote the working depth of tooth.

Let f denote the amount added to depth of tooth for rounding the corners and for clearance.

Let D″ + f denote the whole depth of tooth.

Let π denote the constant 3.1416.

Let P″ denote the circular pitch or the distance from the center of one tooth to the center of the next on the pitch circle.

The examples placed opposite the formulas on the two pages following are for a *single* wheel of 12 pitch, 6.166 in. or 6 2-12 in. diameter, etc., and in the case of the two wheels the larger has the *same* dimensions. The velocities are respectively 1 and 2.

Continued on page 74

For a Single Wheel

Formulas	Examples
$P = \frac{N+2}{D}$	$= \frac{72+2}{6.166}$, or $\frac{72+2}{62-12} = 12.$
P	$\frac{N}{D'} = \frac{72}{6} = 12.$
$D' = \frac{D \times N}{N+2}$	$= \frac{6.166 \times 72}{72+2} = 6.$
$D = \frac{N}{P}$	$= \frac{72}{12} = 6.$
$N = P\,D'$	$= 12 \times 6 = 72.$
$N = P\,D - 2$	$= 12 \times 6.166 - 2$, or $12 \times 6\ 2\text{-}12 - 2 = 72.$
$D = \frac{N+2}{P}$	$= \frac{72+2}{12} = 6.166$, or $6\ 2\text{-}12.$
$D = D' + \frac{2}{P}$	$= 6 + \frac{2}{12}$, or $6 + .166 = 6.166.$
$t = \frac{1.57}{P}$	$= \frac{1.57}{12} = .130.$
$D'' = \frac{2}{P}$	$= \frac{2}{12} = -.166$, or $2\text{-}12.$
$f = \frac{t}{10}$	$= \frac{.130}{10} = .013.$
$D''+f$	$= .166 + .013 = .179.$
$P' = \frac{\pi}{P}$	$= \frac{3.1416}{12} = .262.$
$P = \frac{\pi}{P'}$	$= \frac{3.1416}{.262} = 12.$

Continued on page 75

For a Pair of Wheels

	Formulas	Examples
b	$= 2a\,P$	$= 2\times4.5\times12 = 108.$
n	$= \frac{b\,V}{v+V}$	$= \frac{108\times1}{3} = 36.$
N	$= \frac{n\,v}{V}$	$= \frac{36\times2}{1} = 72.$
n	$= \frac{N\,V}{v}$	$= \frac{72\times1}{2} = 36.$
N	$= \frac{b\,v}{v+V}$	$= \frac{108\times2}{3} = 72.$
n	$= \frac{P\,D'\,V}{v}$	$= \frac{12\times6\times1}{2} = 36.$
V	$= \frac{n\,v}{N}$	$= \frac{36\times2}{72} = 1.$
v	$= \frac{NV}{n}$	$= \frac{72\times1}{36} = 2.$
v	$= \frac{P\,D'\,V}{n}$	$= \frac{12\times6\times1}{36} = 2.$
D	$= \frac{2a(N+2)}{b}$	$= \frac{2\times4.5\times(72+2)}{108} = 6.166.$
d	$= \frac{2a(n\times2)}{b}$	$= \frac{2\times4.5\times(36+2)}{108} = 3.166.$
a	$= \frac{b}{2\,P}$	$= \frac{108}{2\times12} = 4.5.$
D	$= \frac{2\,a\,v}{v+V}$	$= \frac{2\times4.5\times2}{3} = 6.$
d′	$= \frac{2\,a\,V}{v+V}$	$= \frac{2\times4.5\times1}{3} = 3.$
a	$= \frac{D'+d'}{2}$	$= \frac{6+3}{2} = 4.5.$

Sizing and Cutting of Gears

Diametral Pitch Is the Number of Teeth to Each Inch of the Pitch Diameter

To Get	Having	Rule	Formula
The Diametral Pitch.	The Circular Pitch	Divide 3.1416 by the Circular Pitch	$P = \frac{3.1416}{P'}$
The Diametral Pitch.	The Pitch Diameter and the Number of Teeth	Divide Number of Teeth by Pitch Diameter	$P = \frac{N}{D'}$
The Diametral Pitch.	The Outside Diameter and the Number of Teeth	Divide Number of Teeth Plus 2 by Outside Diameter	$P = \frac{N+2}{D}$
Pitch Diameter.	The Number of Teeth and the Diametral Pitch	Divide Number of Teeth by the Diametral Pitch	$D' = \frac{N}{P}$
Pitch Diameter.	The Number of Teeth and Outside Diameter	Divide the product of Outside Diameter and Number of Teeth by Number of Teeth Plus 2	$D' = \frac{D\,N}{N+2}$
Pitch Diameter.	The Outside Diameter and the Diametral Pitch	Subtract from the Outside Diameter the quotient of 2 divided by the Diametral Pitch	$D' = D - \frac{2}{P}$
Pitch Diameter.	Addendum and the Number of Teeth	Multiply Addendum by the Number of Teeth	$D = s\,N$
Outside Diameter.	The Number of Teeth and the Diametral Pitch	Divide Number of Teeth Plus 2 by the Diametral Pitch	$D = \frac{N+2}{P}$
Outside Diameter.	The Pitch Diameter and the Diametral Pitch	Add to the Pitch Diameter the quotient of 2 divided by the Diametral Pitch	$D = D' + \frac{2}{P}$
Outside Diameter.	The Pitch Diameter and the Number of Teeth	Divide the Number of Teeth Plus 2 by the quotient of Number of Teeth divided by Pitch Diameter	$D = \frac{N+2}{N}$
Outside Diameter.	The Number of Teeth and Addendum	Multiply the Number of Teeth Plus 2 by Addendum	$D = (N+2)s$
Number of Teeth.	The Pitch Diameter and the Diametral Pitch	Multiply Pitch Diameter by the Diametral Pitch	$N = D'P$
Number of Teeth.	The Outside Diameter and the Diametral Pitch	Multiply Outside Diameter by the Diametral Pitch and subtract 2	$N = D\,P - 2$
Thickness of Tooth.	The Diametral Pitch	Divide 1.5708 by the Diametral Pitch	$t = \frac{1.5708}{P}$
Addendum.	The Diametral Pitch	Divide 1 by the Diametral Pitch or $s = \frac{D'}{N}$	$s = \frac{1}{P}$
Root.	The Diametral Pitch	Divide 1.157 by the Diametral Pitch	$s+f = \frac{1.157}{P}$
Working Depth.	The Diametral Pitch	Divide 2 by the Diametral Pitch	$D'' = \frac{2}{P}$
Whole Depth.	The Diametral Pitch	Divide 2.157 by the Diametral Pitch	$D'' + f = \frac{2.157}{P}$
Clearance.	The Diametral Pitch	Divide 1.57 by the Diametral Pitch	$f = \frac{1.57}{P}$
Clearance.	Thickness of Tooth	Divide thickness of Tooth at Pitch Line by 10	$f = \frac{t}{10}$

Continued on page 77

Sizing and Cutting of Gears—continued

CIRCULAR PITCH

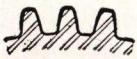
Circular Pitch Is the Distance from the Center of One Tooth to the Center of the Next Tooth, Measured Along the Pitch Circle

To Get	Having	Rule	Formula
The Circular Pitch.	The Diametral Pitch	Divide 3.1416 by the Diametral Pitch	$P' = \frac{3.1416}{P}$
The Circular Pitch.	The Pitch Diameter and the Number of Teeth	Divide Pitch Diameter by the product of .3183 and Number of Teeth	$P' = \frac{D'}{.3183\ N}$
The Circular Pitch.	The Outside Diameter and the Number of Teeth	Divide Outside Diameter by the product of .3183 and Number of Teeth Plus 2	$P' = \frac{D}{.3183\ N+2}$
Pitch Diameter.	The Number of Teeth and the Circular Pitch	The continued product of the Number of Teeth, the Circular Pitch and .3183	$D' = N\ P'.3183$
Pitch Diameter.	The Number of Teeth and the Outside Diameter	Divide the product of Number of Teeth and Outside Diameter by Number of Teeth Plus 2	$D' = \frac{N\ D}{(N+2)}$
Pitch Diameter.	The Outside Diameter and the Circular Pitch	Subtract from the Outside Diameter the product of the Circular Pitch and .6366	$D' = D-(P'.6366)$
Pitch Diameter.	Addendum and the Number of Teeth.	Multiply the Number of Teeth by the Addendum	$D' = N\ s$
Outside Diameter.	The Number of Teeth and the Circular Pitch	The continued product of the Number of Teeth Plus 2 the Circular Pitch and .3183	$D = \frac{(N+2)P'}{.3183}$
Outside Diameter.	The Pitch Diameter and the Circular Pitch	Add to the Pitch Diameter the product of the Circular Pitch and .6366	$D = D' + (P'.6366)$
Outside Diameter.	The Number of Teeth and the Addendum	Multiply Addendum by Number of Teeth Plus 2	$D = s(N+2)$
Number of Teeth.	The Pitch Diameter and the Circular Pitch	Divide the product of Pitch Diameter and 3.1416 by the Circular Pitch	$N = \frac{D'3.1416}{P}$
Thickness of Tooth.	The Circular Pitch.	One-half the Circular Pitch	$t = \frac{P'}{2}$
Addendum.	The Circular Pitch	Multiply the Circular Pitch by .3183, or $s = \frac{D'}{N}$	$s = P'.3183$
Root.	The Circular Pitch.	Multiply the Circular Pitch by .3683	$s + f = P'.3683$
Working Depth.	The Circular Pitch.	Multiply the Circular Pitch by .6366	$D'' = P'.6366$
Whole Depth.	The Circular Pitch.	Multiply the Circular Pitch by .6866	$D'' = P'.6866$
Clearance.	The Circular Pitch.	Multiply the Circular Pitch by .05	$f = P\ .05$
Clearance.	Thickness of Tooth.	One-tenth the Thickness of Tooth at Pitch Line	$f = \frac{t}{10}$

Comparative Sizes of Gear Teeth—Involute

20 DIAM. PITCH.
.1571" CIR. PITCH.

18 DIAM. PITCH.
.1745" CIR. PITCH.

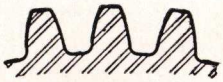


16 DIAM. PITCH.
.1963" CIR. PITCH.

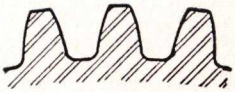
14 DIAM. PITCH
.2244" CIR. PITCH.

12 DIAM. PITCH.
.2618" CIR. PITCH.

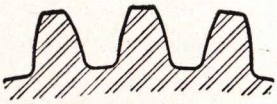
10 DIAM. PITCH.
.3142" CIR. PITCH



9 DIAM. PITCH.
.3491" CIR. PITCH.



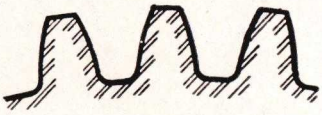
8 DIAM. PITCH.
.3927" CIR. PITCH.



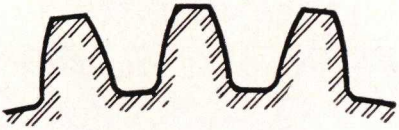
7 DIAM. PITCH.
.4488" CIR. PITCH

Continued on page 79

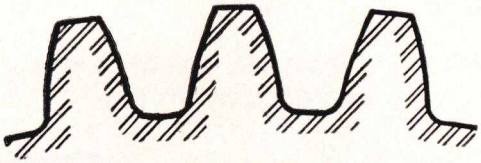
Comparative Sizes of Gear Teeth—Involute—continued



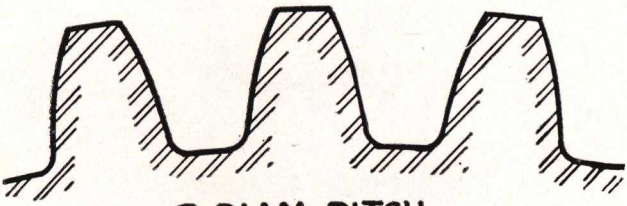
6 DIAM. PITCH.
.5236" CIR. PITCH.



5 DIAM. PITCH.
.6283" CIR. PITCH.



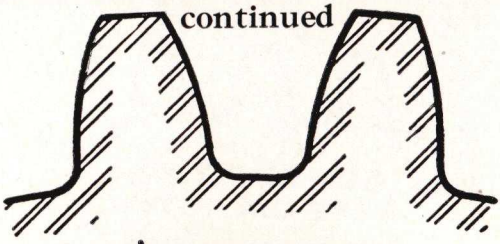
4 DIAM. PITCH.
.7854" CIR. PITCH.



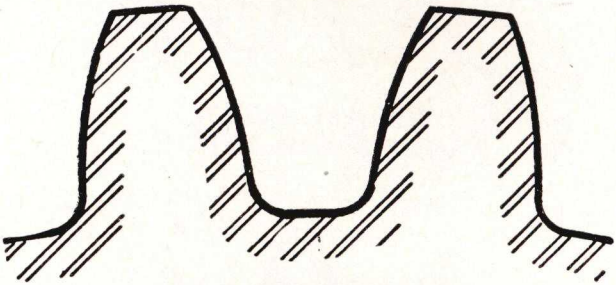
3 DIAM. PITCH.
1.0472" CIR. PITCH

Continued on page 80

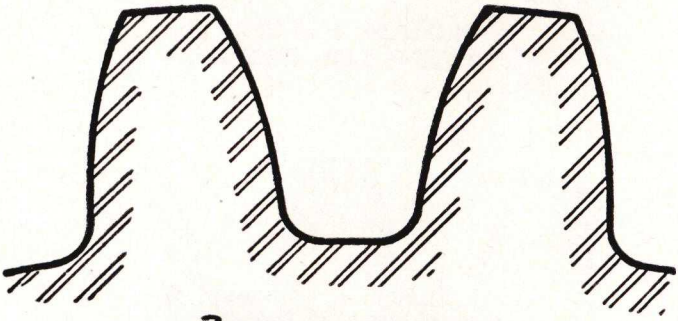
Comparative Sizes of Gear Teeth—Involute—continued



2½ DIAM. PITCH.
1.2566" CIR. PITCH.



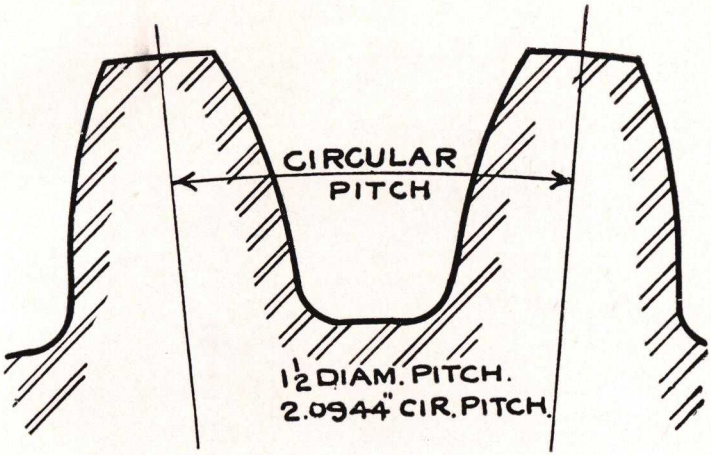
2 DIAM. PITCH.
1.5708" CIR. PITCH.

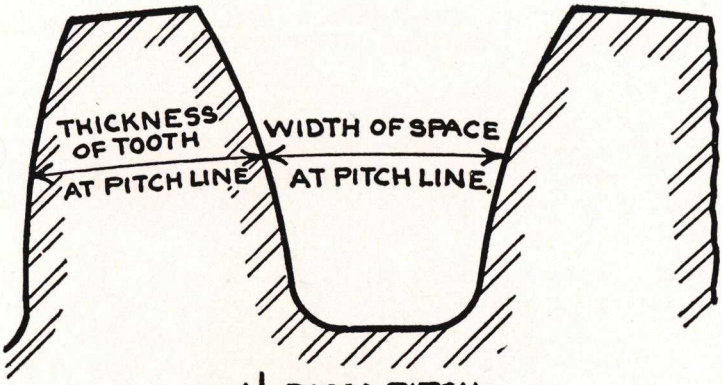


1¾ DIAM. PITCH
1.7952" CIR. PITCH.

Continued on page 81

Comparative Sizes of Gear Teeth—Involute—continued

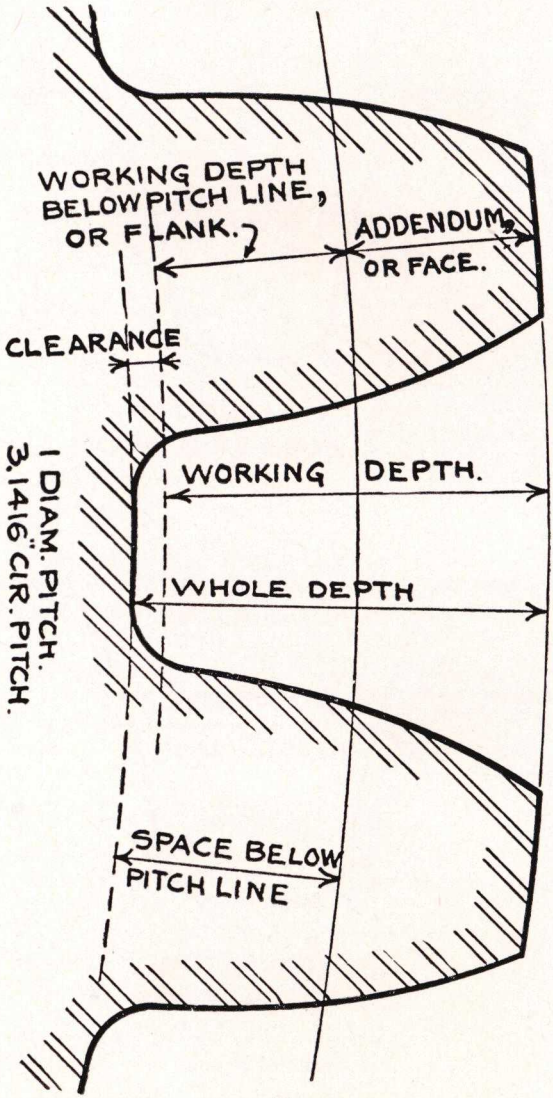




1¼ DIAM. PITCH.
2.5133" CIR. PITCH.

Continued on page 82

Comparative Sizes of Gear Teeth—Involute—continued



Cutters for Mitre and Bevel Gears

Mitre Gears are Bevel Gears having the same number of teeth and whose center lines intersect at right angles.

A pair of Mitre Gears can be cut with one cutter, but a pair of Bevel Gears that are not Mitres may require two cutters.

Cutters for Bevel Gears are of similar form to those for Spur Gears except for the thickness, which must be no greater than the space between the teeth of the gears at their inside ends. The stock cutters are thin enough to cut a gear whose tooth face is not longer than one-third the distance from the outer ends of the teeth to the point where the center lines of the gears intersect.

Eight cutters are made for each pitch in accordance with table on pages 86–89. In cutting a Bevel Gear it is usually necessary to use a cutter of a shape adapted for a greater number of teeth than the number of teeth in the gear to be cut. The number of cutter for each gear of a pair may be found as follows:—First, find the center angle of the larger gear by dividing the number of teeth in same manner by the number of teeth in the smaller gear; the result will be the tangent of the center angle which may be found by reference to a table of tangents. The number of teeth in the larger gear divided by the cosine of this center angle will give the number of teeth for which a cutter should be selected to cut the larger gear. The number of teeth in the smaller gear divided by the sine of this same center angle will give the number of teeth for which a cutter should be selected to cut the smaller gear. In the case of Mitre Gears, this is equivalent to multiplying the number of teeth in one of the gears by 1.41 and selecting a cutter for the number of teeth indicated by the product.

Example:—To select a cutter for mitres of 50 T, multiply 50 by 1.41. The product 70.5 shows that a cutter of shape No. 2 for 55 to 134 T is the one required.

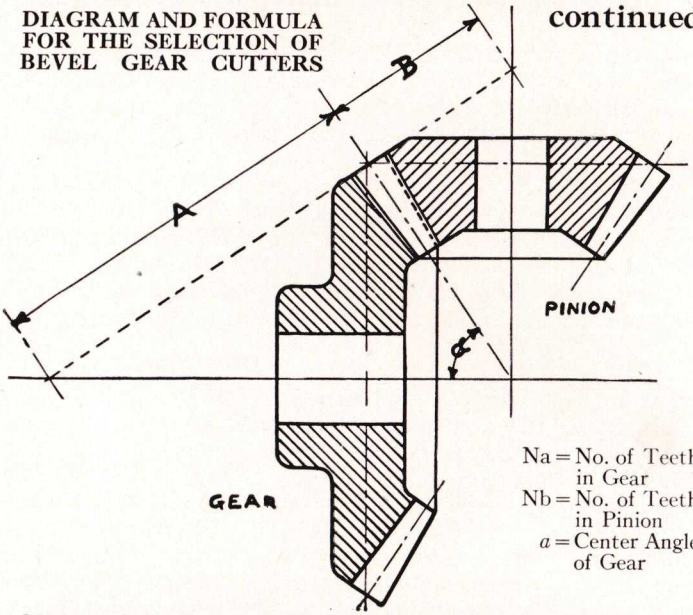
In ordering always state the number of teeth in each gear, pitch, length of face and the angle of shafts when different from a right angle.

Diagram on page 84.

Continued on page 84

Cutters for Mitre and Bevel Gears—continued

DIAGRAM AND FORMULA FOR THE SELECTION OF BEVEL GEAR CUTTERS



Na = No. of Teeth in Gear
Nb = No. of Teeth in Pinion
a = Center Angle of Gear

Measure the back cone radius A for the gear or B for the pinion. This is equal to the radius of a spur gear, the number of teeth in which would determine the cutter to use. Hence twice A times the diametral pitch equals the number of teeth for which the cutter should be selected for the gear. Looking in the list on pages 86–89 the proper number for the cutter can be found.

Thus, let the back cone radius A be 3″ and the diametral pitch be 6. Twice 3 is 6 and 6 x 6 is 36, from which it can be seen that the cutter must be of shape No. 3, as 36 is between 35 and 54, the range covered by a No. 3 Cutter.

The number of teeth for which the cutter should be selected can also be found by following formula:

$$\text{Tan. } a = \frac{\text{Na}}{\text{Nb}}$$

$$\text{No. of teeth to select cutter for gear} = \frac{\text{Na}}{\text{Cos. } a}$$

$$\text{No. of teeth to select cutter for pinion} = \frac{\text{Nb}}{\text{Sin. } a}$$

If the gears are mitres or alike, only one cutter is needed; if one gear is larger than the other, two may be needed.

Continued on page 85

Cutters for Mitre and Bevel Gears—continued

There are eight cutters numbered 1 to 8 inclusive made for each pitch. The tables on pages 86 to 89 inclusive are for use in selecting the number of cutter for cutting Bevel and Mitre Gears and apply only to Bevel Gears with axis at right angles.

The number of cutter to use will be found at the intersection of the two columns representing the number of teeth in the gear and pinion to be cut.

For Example:

If the number of teeth in the gear is 30, and the number of teeth in the pinion is 16, at the intersection will be found numbers 2 and 6, indicating the 30 tooth gear should be cut with a No. 2 Cutter and the 16 tooth pinion should be cut with a No. 6 Cutter.

Carbon Steel No. R280 — High Speed Steel No. R680

Diametral Pitch	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
3	4	1¼	$10.00	$19.90
4	3⅝	1¼	8.20	16.40
5	3⅜	1¼	7.20	14.30
6	3⅛	1	6.20	12.30
7	2⅞	1	5.40	10.70
8	2⅞	1	5.10	10.20
10	2⅜	⅞	4.10	8.20
12	2¼	⅞	3.60	7.20
14	2⅛	⅞	3.50	6.90
16	2⅛	⅞	3.50	6.90
20	2	⅞	3.10	6.20
24	1¾	⅞	3.00	6.00

For Gauges see page 278.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 86

Cutters for Use in Cutting Bevel Gears

PINION

GEAR	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
12	7-7																		
13	6-7	6-6																	
14	5-7	6-6	6-6																
15	5-7	5-6	5-6	5-5															
16	4-7	5-7	5-6	5-6	5-5														
17	4-7	4-7	4-6	5-6	5-5	5-5													
18	4-7	4-7	4-6	4-6	4-5	4-5	5-5												
19	3-7	4-7	4-6	4-6	4-6	4-5	4-5	4-4											
20	3-7	3-7	4-6	4-6	4-6	4-5	4-5	4-4	4-4										
21	3-8	3-7	3-7	3-6	4-6	4-5	4-5	4-5	4-4	4-4									
22	3-8	3-7	3-7	3-6	3-6	3-5	4-5	4-5	4-4	4-4	4-4								
23	3-8	3-7	3-7	3-6	3-6	3-5	3-5	3-5	3-4	4-4	4-4	4-4							
24	3-8	3-7	3-7	3-6	3-6	3-6	3-5	3-5	3-4	3-4	3-4	4-4	4-4						
25	2-8	2-7	3-7	3-6	3-6	3-6	3-5	3-5	3-5	3-4	3-4	3-4	4-4	3-3					
26	2-8	2-7	3-7	3-6	3-6	3-6	3-5	3-5	3-5	3-4	3-4	3-4	3-4	3-3	3-3				
27	2-8	2-7	2-7	2-6	3-6	3-6	3-5	3-5	3-5	3-4	3-4	3-4	3-4	3-4	3-3	3-3			
28	2-8	2-7	2-7	2-6	2-6	3-6	3-5	3-5	3-5	3-4	3-4	3-4	3-4	3-4	3-3	3-3	3-3		
29	2-8	2-7	2-7	2-7	2-6	2-6	3-5	3-5	3-5	3-4	3-4	3-4	3-4	3-4	3-3	3-3	3-3	3-3	
30	2-8	2-7	2-7	2-7	2-6	2-6	2-5	2-5	3-5	3-5	3-4	3-4	3-4	3-4	3-4	3-3	3-3	3-3	3-3
31	2-8	2-7	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	3-4	3-4	3-4	3-4	3-4	3-3	3-3	3-3	3-3
32	2-8	2-7	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-4	2-4	3-4	3-4	3-4	3-3	3-3	3-3	3-3
33	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-4	2-4	2-4	3-4	3-4	3-4	3-3	3-3	3-3
34	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	3-4	3-3	3-3	3-3
35	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3	3-3	3-3
36	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-3	2-3	2-3
37	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-3	2-3	2-3
38	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3	2-3
39	2-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3	2-3
40	1-8	2-8	2-7	2-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3	2-3
41	1-8	1-8	2-7	2-7	2-6	2-6	2-6	2-6	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3	2-3
42	1-8	1-8	2-7	2-7	2-6	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-3	2-3
43	1-8	1-8	1-7	2-7	2-6	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
44	1-8	1-8	1-7	1-7	2-6	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
45	1-8	1-8	1-7	1-7	1-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
46	1-8	1-8	1-7	1-7	1-7	2-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
47	1-8	1-8	1-7	1-7	1-7	1-6	2-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
48	1-8	1-8	1-7	1-7	1-7	1-6	1-6	2-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
49	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
50	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	2-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-3
51	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	2-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-4
52	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	2-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-4
53	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	2-5	2-4	2-4	2-4	2-4	2-4	2-4	2-4
54	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	2-4	2-4	2-4	2-4	2-4	2-4	2-4
55	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	2-4	2-4	2-4	2-4	2-4	2-4

Continued on page 87

Cutters for Use in Cutting Bevel Gears—continued

PINION

GEAR	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
31	3-3																			
32	3-3	3-3																		
33	3-3	3-3	3-3																	
34	3-3	3-3	3-3	3-3																
35	3-3	3-3	3-3	3-3	3-3															
36	2-3	3-3	3-3	3-3	3-3	3-3														
37	2-3	2-3	2-3	2-3	3-3	3-3	3-3													
38	2-3	2-3	2-3	2-3	2-3	3-3	3-3	3-3												
39	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2											
40	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2										
41	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2									
42	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2								
43	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2							
44	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2						
45	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2					
46	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2				
47	2-3	2-3	2-3	2-3	2-3	2 3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2			
48	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2 3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2		
49	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2 3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	
50	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
51	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
52	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
53	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
54	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
55	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2

Continued on page 88

Cutters for Use in Cutting Bevel Gears—continued

PINION

GEAR	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
56	1-8	1-8	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	2-4	2-4	2-4	2-4	2-4
57	1-8	1-8	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	2-4	2-4	2-4	2-4
58	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	2-4	2-4	2-4
59	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	2-4	2-4
60	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	2-4
61	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
62	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
63	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
64	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
65	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
66	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
67	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
68	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
69	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
70	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
71	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
72	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
73	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
74	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
75	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
76	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
77	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
78	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
79	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
80	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
81	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
82	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
83	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
84	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
85	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
86	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
87	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
88	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
89	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
90	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
91	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
92	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
93	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
94	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
95	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
96	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
97	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
98	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
99	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4
100	1-8	1-8	1-7	1-7	1-7	1-6	1-6	1-6	1-6	1-5	1-5	1-5	1-5	1-4	1-4	1-4	1-4	1-4	1-4

Continued on page 89

Cutters for Use in Cutting Bevel Gears—continued

PINION

GEAR	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
56	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2
57	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2
58	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2
59	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2	2-2
60	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2
61	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2
62	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2
63	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2	2-2
64	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2 2	2-2	2-2	2-2	2-2	2-2
65	1-4	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2 3	2-3	2-2	2-2	2-2	2-2	2-2	2-2
66	1-4	1-3	1-3	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2
67	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2
68	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2
69	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2
70	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	2-3	2-3	2-3	2-2	2-2	2-2	2-2	2-2
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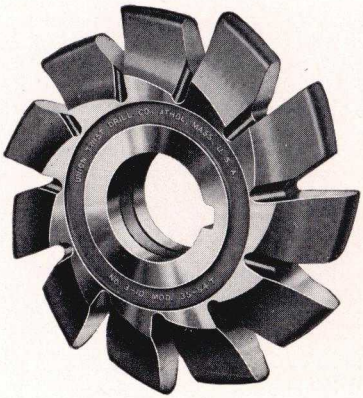
72	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	2-2	2-2	2-2	2-2	2-2
73	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	2-2	2-2	2-2
74	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	2-2	2-2
75	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2	1-2
76	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2	1-2
77	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2	1-2
78	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2	1-2
79	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2	1-2
80	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
81	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1 3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
82	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
83	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1 3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
84	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
85	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
86	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
87	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
88	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
89	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2	1-2
90	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
91	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
92	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
93	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
94	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
95	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
96	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1 3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
97	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
98	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
99	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2
100	1-4	1-4	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-2	1-2

Metric Involute Gear Cutters



We are prepared to furnish, at short notice, cutters for cutting the teeth of Gear Wheels according to the Metric system.

Module is the Pitch Diameter in mm. divided by the number of teeth in the gear.

Pitch Diameter in mm. is the Module multiplied by the number of teeth in the gear.

M = Module. D′ = Pitch Diameter in mm.

N = No. of Teeth in Gear. D′ = M x N.

For example: M = 4 mm.; N = 50; D′ = 4 x 50 = 200 mm.

For Gauges see page 278.

For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 91

Metric Involute Gear Cutters—continued

STANDARD KEYWAYS

There are eight cutters numbered 1 to 8 inclusive made for each pitch and commonly referred to as Range Numbers. These eight cutters are adapted to cut from a pinion of 12 teeth to a rack, see page 59 for Range numbers.

Involute Gear Cutters designed to cut an exact number of teeth are known as Single Purpose Cutters and are made to order. Prices on application.

In ordering, specify No. of cutter or range number, Module m/m, and size of hole required. If a Single Purpose Cutter is wanted state the exact number of teeth to be cut.

When required, Form Ground Gear Cutters can be furnished. Prices on application.

Carbon Steel No. R220 — High Speed Steel No. R620

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
1/2	1 3/4	7/8″ or 22 m/m	$2.90	$5.80
3/4	1 3/4	7/8″ or 22	2.90	5.80
1	1 3/4	7/8″ or 22	3.00	6.00
1 1/4	2	7/8″ or 22	3.10	6.20
1 1/2	2 1/8	7/8″ or 22	3.50	6.90
1 3/4	2 1/8	7/8″ or 22	3.50	6.90
2	2 1/4	7/8″ or 22	3.60	7.20
2 1/4	2 3/8	7/8″ or 22	4.00	7.90
2 1/2	2 3/8	7/8″ or 22	4.10	8.20
2 3/4	2 3/4	1″ or 27	4.50	9.00
3	2 7/8	1″ or 27	5.10	10.20
3 1/4	2 7/8	1″ or 27	5.40	10.70
3 1/2	2 7/8	1″ or 27	5.40	10.70
3 3/4	2 7/8	1″ or 27	5.70	11.30
4	3 1/8	1″ or 27	6.20	12.30
4 1/4	3 1/8	1″ or 27	6.20	12.30

For Gauges see page 278.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

List continued on page 92

Metric Involute Gear Cutters—continued

STANDARD KEYWAYS

Carbon Steel No. R220 — High Speed Steel No. R620

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
4½	3¾	1¼″ or 32 m/m	$7.30	$14.50
4¾	3¾	1¼″ or 32	7.80	15.50
5	3¾	1¼″ or 32	7.80	15.50
5¼	3¾	1¼″ or 32	7.80	15.50
5½	4	1¼″ or 32	8.40	16.70
5¾	4	1¼″ or 32	8.90	17.80
6	4¼	1¼″ or 32	9.60	19.20
7	4½	1¼″ or 32	11.00	22.00
8	4¾	1¼″ or 32	12.60	25.10
9	5½	1½″ or 40	16.50	33.00
10	5¾	1½″ or 40	20.00	40.00
11	5¾	1½″ or 40	21.10	42.20
12	5¾	1½″ or 40	22.30	44.50

WITH 1 INCH OR 27 M/M HOLE — Keyway ¼ x 3/32

Carbon Steel No. R230 — High Speed Steel No. R630

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
1	2¼	1″ or 27 m/m	$3.50	$6.90
1¼	2⅜	1″ or 27	3.80	7.60
1½	2½	1″ or 27	3.80	7.60
1¾	2½	1″ or 27	3.80	7.60
2	2⅝	1″ or 27	4.30	8.60
2¼	2⅝	1″ or 27	4.30	8.60
2½	2¾	1″ or 27	4.50	9.00
4½	3¼	1″ or 27	6.20	12.30
5	3⅜	1″ or 27	7.20	14.30
5½	3½	1″ or 27	7.20	14.30
6	3⅝	1″ or 27	8.20	16.40

WITH 1¼ INCH OR 32 M/M HOLE — Keyway 5/16 x ⅛

Carbon Steel No. R240 — High Speed Steel No. R640

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
2	2⅞	1¼″ or 32 m/m	$4.70	$ 9.40
2¼	2⅞	1¼″ or 32	4.70	9.40
2½	3	1¼″ or 32	4.90	9.80
3	3¼	1¼″ or 32	5.60	11.10
3½	3⅜	1¼″ or 32	6.30	12.60
4	3½	1¼″ or 32	6.70	13.40

Eight Cutters made for each pitch see page 59.
For Gauges see page 278.
For Keyway see page 8.
For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 93

Metric Involute Gear Cutters—continued

WITH 1½ INCH OR 40 M/M HOLE Keyway ⅜ x 5/32

Carbon Steel No. R250 High Speed Steel No. R650

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
3	3½	1½″ or 40 m/m	$ 6.10	$12.10
3½	3⅝	1½″ or 40	6.80	13.50
4	3⅞	1½″ or 40	7.90	15.70
4½	4⅛	1½″ or 40	8.40	16.80
5	4¼	1½″ or 40	9.00	18.00
5½	4⅜	1½″ or 40	9.70	19.40
6	4½	1½″ or 40	10.40	20.70
7	4⅞	1½″ or 40	12.80	25.50
8	5¼	1½″ or 40	14.50	29.00

WITH 1¾ INCH OR 45 M/M HOLE Keyway 7/16 x 3/16

Carbon Steel No. R260 High Speed Steel No. R660

Module m/m	Dimensions—Inches		Price Each	
	Diameter Cutter	Size Hole	Carbon Steel	High Speed Steel
4	4¼	1¾″ or 45 m/m	$ 8.40	$16.80
4½	4⅜	1¾″ or 45	9.10	18.10
5	4⅜	1¾″ or 45	9.70	19.40
5½	4⅝	1¾″ or 45	10.40	20.80
6	4¾	1¾″ or 45	11.10	22.20
7	5¼	1¾″ or 45	13.70	27.30
8	5⅝	1¾″ or 45	17.80	35.50
9	5⅞	1¾″ or 45	18.90	37.70
10	6⅛	1¾″ or 45	23.70	47.30
11	6½	1¾″ or 45	25.00	49.90
12	6½	1¾″ or 45	26.30	52.60

Eight Cutters made for each pitch see page 59.
For Gauges see page 278.
For Keyway see page 8.
For Grinding Machine and Fixtures see pages 288–289, 297.

Continued on page 94

Metric Involute Gear Cutters—continued

FORMULAS FOR DETERMINING THE DIMENSIONS OF GEARS BY METRIC PITCH

Module is the Pitch Diameter in mm. divided by the number of teeth in the gear.

Pitch Diameter in mm. is the Module multiplied by the number of teeth in the gear.

M = Module.

D′ = The pitch diameter of gear.

D = The whole diameter of gear.

N = The number of teeth in gear.

D″ = The working depth of teeth.

t = Thickness of teeth on pitch line.

f = Amount added to depth for clearance.

Then

$$M = \frac{D'}{N} \text{ or } \frac{D}{N+2}.$$

$$D' = N\,M.$$

$$D = (N + 2)\,M.$$

$$N = \frac{D'}{M} \text{ or } \frac{D}{M} - 2.$$

$$D'' = 2M.$$

$$t = M\ 1.5708$$

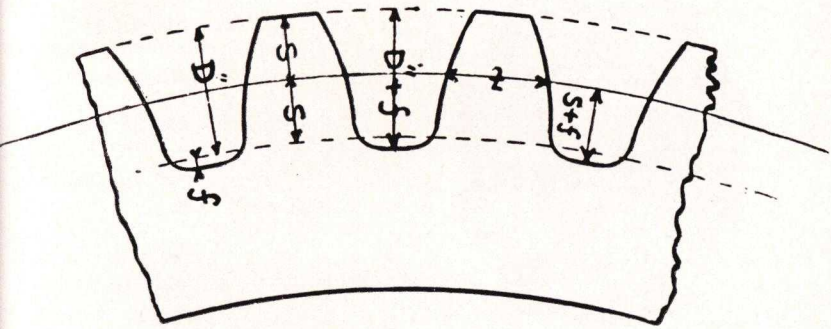
$$f = \frac{M\ 1.5708}{10} = 1.57\ M.$$

The Module is equal to the part marked "S" in cut, on following page, measured in mm. and parts of mm.

Continued on page 95

Metric Involute Gear Cutters—continued

PITCHES COMMONLY USED



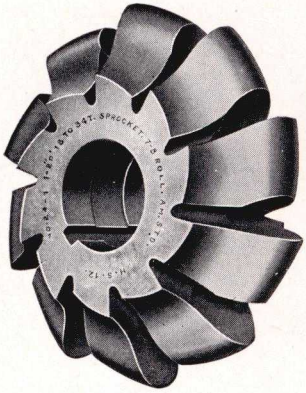
Module in Millimeters

Module, mm.	Corresponding English Diametral Pitch	Module, mm.	Corresponding English Diametral Pitch
½	50.800	4	6.350
¾	33.867	4.5	5.644
1	25.400	5	5.080
1.25	20.320	5.5	4.618
1.5	16.933	6	4.233
1.75	14.514	7	3.628
2	12.700	8	3.175
2.25	11.288	9	2.822
2.5	10.160	10	2.540
2.75	9.236	11	2.309
3	8.466	12	2.117
3.5	7.257		

Sprocket Wheel Cutters for Roller Chains

AMERICAN STANDARD TOOTH FORMS

ADOPTED BY S.A.E., A.S.M.E., A.G.M.A.



Sprocket Wheel Cutters have formed teeth and can be sharpened by grinding without changing their outline.

In ordering specify circular pitch, diameter of roll, number of teeth in sprocket, diameter of cutter, size hole, carbon or high speed steel.

These cutters can be furnished promptly. Prices on application.

Carbon Steel No. S100 — High Speed Steel No. S500

Dimensions Inches		No. of Teeth in Sprocket	Dimensions—Inches			Price Each	
Circular Pitch	Diam. of Roll		Diam. of Cutter	Width of Cutter	Size of Hole	Carbon Steel	High Speed Steel
3/8	.200	6	2 3/4	15/32	1	Prices on Application	Prices on Application
		7 to 8	2 3/4	15/32			
		9 to 11	2 3/4	15/32			
		12 to 17	2 3/4	7/16			
		18 to 34	2 3/4	7/16			
		35 and over	2 3/4	13/32			
1/2 to 5/8	.313	6	3	3/4	1		
		7 to 8	3	3/4			
		9 to 11	3 1/8	3/4			
		12 to 17	3 1/8	3/4			
		18 to 34	3 1/8	23/32			
		35 and over	3 1/8	11/16			

Formulas for calculating diameters of sprocket wheels for roller chains see page 99.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

List continued on page 97

Sprocket Wheel Cutters for Roller Chains—continued

AMERICAN STANDARD TOOTH FORMS

ADOPTED BY S.A.E., A.S.M.E., A.G.M.A.

Carbon Steel No. S100 — High Speed Steel No. S500

Dimensions Inches		No. of Teeth in Sprocket	Dimensions—Inches			Price Each	
Circular Pitch	Diam. of Roll		Diam. of Cutter	Width of Cutter	Size of Hole	Carbon Steel	High Speed Steel
5/8	.400	6	3 1/8	3/4	1	Prices on Application	Prices on Application
		7 to 8	3 1/8	3/4			
		9 to 11	3 1/4	3/4			
		12 to 17	3 1/4	3/4			
		18 to 34	3 1/4	23/32			
		35 and over	3 1/4	11/16			
3/4	.469	6	3 1/4	29/32	1		
		7 to 8	3 1/4	29/32			
		9 to 11	3 3/8	29/32			
		12 to 17	3 3/8	7/8			
		18 to 34	3 3/8	27/32			
		35 and over	3 3/8	13/16			
1	.563	6	3 3/4	1 1/4	1 1/4		
		7 to 8	3 7/8	1 1/4			
		9 to 11	3 7/8	1 3/16			
		12 to 17	4	1 5/32			
		18 to 34	4	1 1/8			
		35 and over	4	1 3/32			
1 to 1 1/4	.625	6	3 7/8	1 1/2	1 1/4		
		7 to 8	4	1 1/2			
		9 to 11	4 1/8	1 15/32			
		12 to 17	4 1/8	1 15/32			
		18 to 34	4 1/4	1 13/32			
		35 and over	4 1/4	1 11/32			
1 1/4 to 1 1/2	.750	6	4 1/4	1 13/16	1 1/4		
		7 to 8	4 3/8	1 13/16			
		9 to 11	4 1/2	1 25/32			
		12 to 17	4 1/2	1 3/4			
		18 to 34	4 5/8	1 11/16			
		35 and over	4 5/8	1 5/8			

Formulas for calculating diameters of sprocket wheels for roller chains see page 99.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

List continued on page 98

Sprocket Wheel Cutters for Roller Chains—continued

AMERICAN STANDARD TOOTH FORMS

ADOPTED BY S.A.E., A.S.M.E., A.G.M.A.

Carbon Steel No. S100 — High Speed Steel No. S500

Dimensions Inches		No. of Teeth in Sprocket	Dimensions—Inches			Price Each	
Circular Pitch	Diam. of Roll		Diam. of Cutter	Width of Cutter	Size of Hole	Carbon Steel	High Speed Steel
1½	.875	6	4 3/8	1 13/16	1¼	Prices on Application	Prices on Application
		7 to 8	4½	1 13/16			
		9 to 11	4 5/8	1 25/32			
		12 to 17	4 5/8	1 3/4			
		18 to 34	4 3/4	1 11/16			
		35 and over	4 3/4	1 5/8			
1¾	1.000	6	5	2 3/32	1½		
		7 to 8	5 1/8	2 3/32			
		9 to 11	5¼	2 1/16			
		12 to 17	5 3/8	2 1/32			
		18 to 34	5½	1 31/32			
		35 and over	5½	1 7/8			
2	1.125	6	5 3/8	2 13/32	1½		
		7 to 8	5½	2 13/32			
		9 to 11	5 5/8	2 3/8			
		12 to 17	5¾	2 5/16			
		18 to 34	5 7/8	2 1/4			
		35 and over	5 7/8	2 5/32			
2½	1.5625	6	6 3/8	3	1¾		
		7 to 8	6 5/8	3			
		9 to 11	6¾	2 15/16			
		12 to 17	6 7/8	2 29/32			
		18 to 34	7	2 3/4			
		35 and over	7 1/8	2 11/16			
3	1.900	6	7½	3 19/32	2		
		7 to 8	7¾	3 19/32			
		9 to 11	7 7/8	3 17/32			
		12 to 17	8	3 15/32			
		18 to 34	8	3 11/32			
		35 and over	8¼	3 7/32			

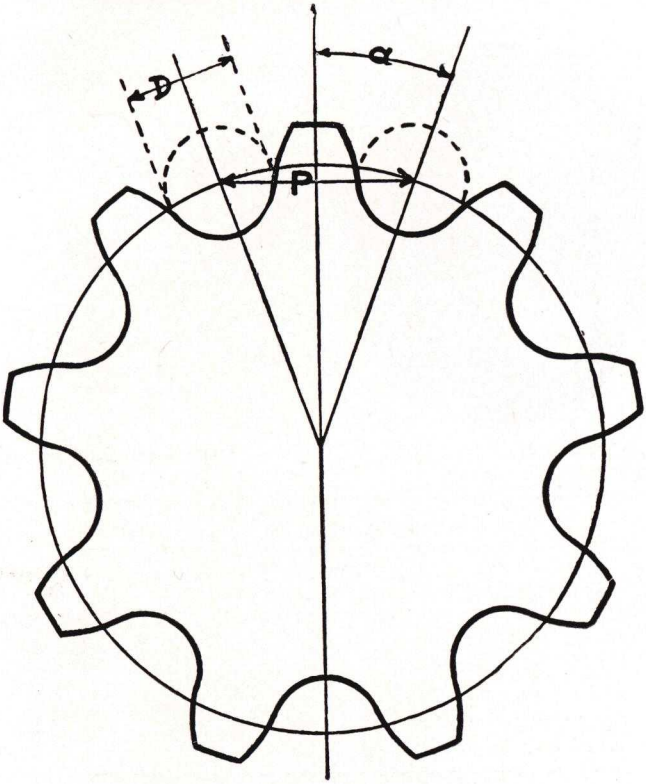
Formulas for calculating diameters of sprocket wheels for roller chains see page 99.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

Formulas

FOR CALCULATING DIAMETERS OF SPROCKET WHEELS FOR ROLLER CHAINS



N = Number of Teeth in Sprocket.
P = Pitch of Chain.
D = Diameter of Roll.

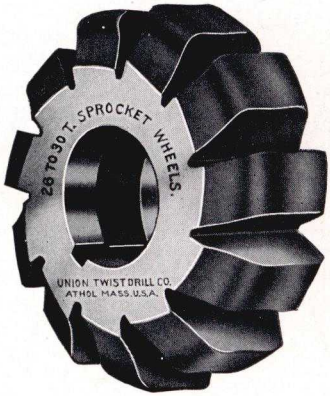
$$a = \frac{180^\circ}{N}$$

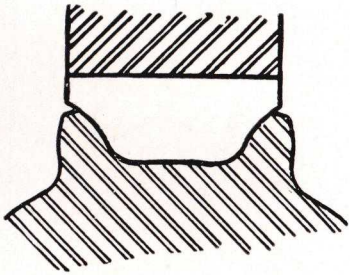
$$\text{Pitch Diameter} = \frac{P}{\text{Sin. } a}$$

Outside Diameter = Pitch Diam. + D.
Bottom Diameter = Pitch Diam. — D.

Sprocket Wheel Cutters

FOR THE ORDINARY 1″ PITCH BLOCK CENTER CHAINS





Carbon Steel No. S110

High Speed Steel No. S510

No. of Teeth of Sprocket	Dimensions—Inches		Price Each	
	Diameter of Cutter	Hole in Cutter	Carbon Steel	High Speed Steel
6	3	1	Prices on Application	Prices on Application
7- 8	3	1		
9-11	3	1		
12-17	3	1		
18-34	3	1		
35 and over	3	1		

Formulas for calculating diameters of sprocket wheels for block center chains see page 101.

For diameters of sprocket wheels see page 102.

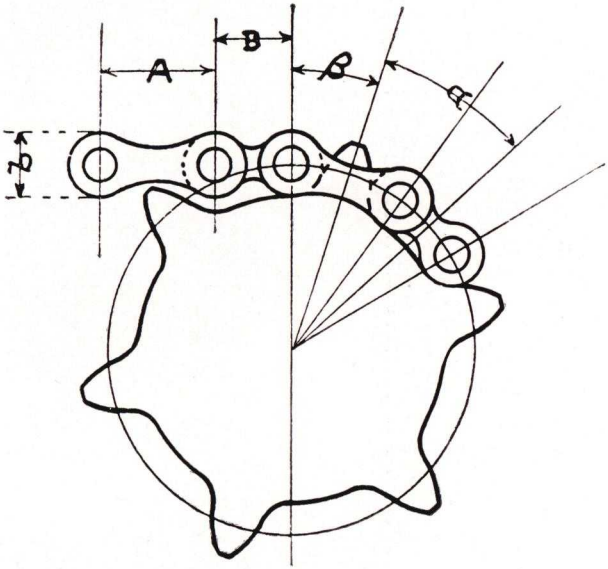
We are prepared to furnish cutters for the various SILENT CHAIN SPROCKETS. Prices on application.

For Keyway see page 8.

For Grinding Machine and Fixtures see pages 288–289, 297.

Formulas

FOR CALCULATING DIAMETERS OF SPROCKET WHEELS FOR BLOCK CENTER CHAINS



N = No. of Teeth.

$$a = \frac{180°}{N}$$

B = Diameter of Round Part of Chain Block.

$$\text{Tan. } \beta = \frac{\text{Sin. } a}{\frac{B}{A} + \text{Cos. } a}$$

B = Center to Center of Holes in Chain Block.

A = Center to Center of Holes in Side Links.

$$\text{Pitch Diam.} = \frac{A}{\text{Sin. } \beta}$$

Outside Diameter = Pitch Diam. + b
Bottom Diameter = Pitch Diam. − b

In calculating the diameter of Sprocket Wheels the Bottom Diameter is the most important.

Diameter of Sprocket Wheels

FOR BLOCK CHAINS 1″ PITCH

$A = .6''$ $B = .4''$ $b = .325''$

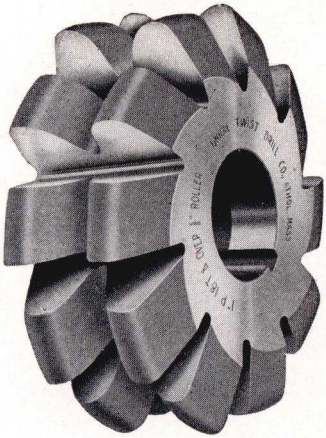
No. of Teeth	Pitch Diameter, Inches	Outside Diameter, Inches	Bottom Diameter, Inches
6	1.935	2.260	1.610
7	2.250	2.575	1.925
8	2.566	2.891	2.241
9	2.882	3.207	2.557
10	3.198	3.523	2.873
11	3.515	3.840	3.190
12	3.832	4.157	3.507
13	4.149	4.474	3.824
14	4.466	4.791	4.141
15	4.784	5.109	4.459
16	5.102	5.427	4.777
17	5.420	5.745	5.095
18	5.738	6.063	5.413
19	6.056	6.381	5.731
20	6.374	6.699	6.049
21	6.692	7.017	6.367
22	7.010	7.335	6.685
23	7.328	7.653	7.003
24	7.646	7.971	7.321
25	7.964	8.289	7.639
26	8.282	8.607	7.957
27	8.600	8.925	8.275
28	8.918	9.243	8.593
29	9.237	9.562	8.912
30	9.556	9.881	9.231

Formulas for calculating diameters of sprocket wheels for block center chains see page 101.

For list of Sprocket Wheel Cutters see page 100.

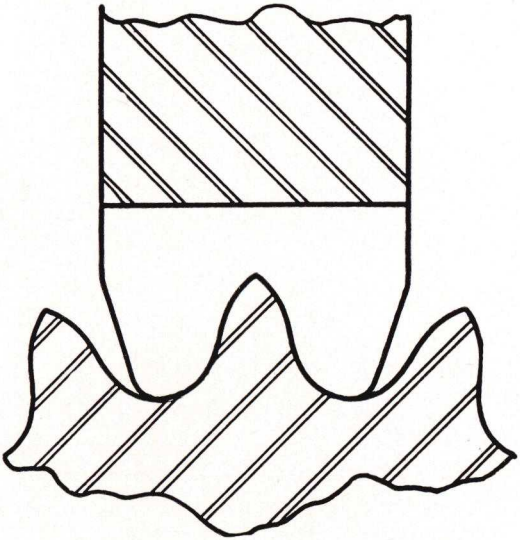
Straddle Tooth Sprocket Cutters for Roller Chains

CARBON OR HIGH SPEED STEEL



Two Cutters will cut any number of teeth, 6 teeth and over; one for cutting 6 to 17 inclusive, and the other 18 teeth and over.

When ordering specify Pitch of Chain, Diameter of Roller, Size of Hole and Keyway in Cutter.



Prices on application.

Hobs

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Hobs and Their Uses

HOBBING

A hob is a cutter having a lead or thread, the form of thread developed to produce teeth of the desired shape equally spaced on a cylindrical base. It is commonly used for cutting teeth in spur and spiral gears, herring-bone gears, worm gears, worms, spline shafts, ratchets, square shafts and sprockets for silent chain, roller chain and block chain.

The hobbing method generates correctly formed teeth having the correct circular pitch. Increase in production and uniformity of work produced has caused the hobbing method to be adopted in preference to other methods which are in general use. The action of the hob is continuous, advancing uniformly as the blank rotates without the intermittent or reciprocating motion commonly found in gear cutting machines. The rise of temperature due to cutting is uniform around the periphery of the blank as the hob and blank both rotate. The cutting is distributed over a considerable length of the hob, bringing a number of cutting edges into action, which not only reduces heat but increases the life of the hob.

One hob of a given pitch will cut all numbers of teeth generating the correct form of tooth for each number of teeth being cut.

Hobs are furnished with threads ground or unground. We recommend the ground hob, particularly for work requiring accuracy. In grinding the thread or form after a hob is hardened, all inaccuracies due to hardening and tempering operations are removed, the lead and form of thread being held to the required limits. Grinding the

Continued on page 108

Hobs and Their Uses—continued

form has a further advantage in that rough surfaces are made smooth, all tool marks and roughness due to the hardening operation being removed, thus producing a smooth and keen cutting edge which will not only produce smoother and better work, but gives longer cutting life between sharpenings.

Every ground hob is carefully tested for accuracy of lead and form in our specially designed and accurately built testing machines. The gashes or teeth are also tested for accuracy of lead and for being radial or undercut, as the case may be.

It is very essential that a ground hob be sharpened with the same degree of accuracy and care as it was originally made. Gashes must be evenly spaced, ground the correct lead and faces radial. Otherwise the work produced by the hob will have a rough and uneven surface.

It is vitally essential to be certain that a ground hob is running true when working in the hobbing machine. All hobs are made with a projecting hub on each end for convenience in indicating the hob after it is mounted on the hobbing machine arbor. To obtain the best results these hubs should run true within .001 inch or less. The successful use of hobs depends on the condition and accuracy of the hobbing machine as well as the hob. Slides and spindles must be properly adjusted. The work arbor must run true and work should be rigidly supported.

The speed and feed at which hobs should run depend largely on the kind and nature of material to be cut, also the finish desired. Approximate speeds and feeds, however, can be given. Unless otherwise specified High Speed Steel Hobs will be furnished.

Continued on page 109

Hobs and Their Uses—continued

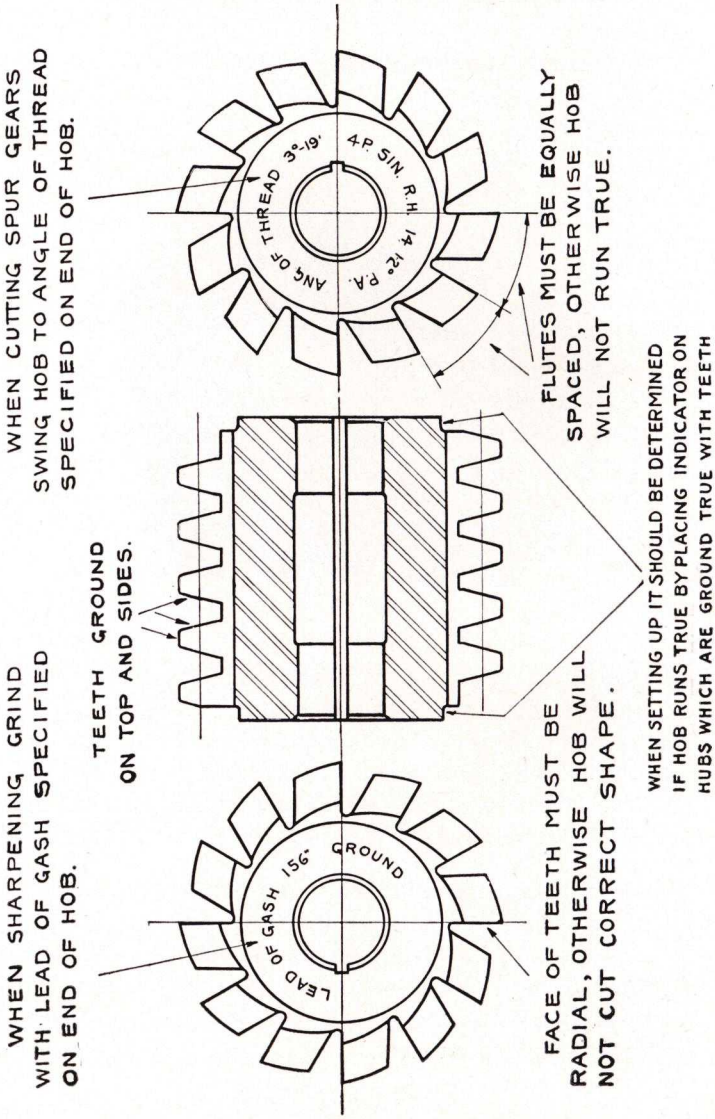
HOBS FOR SPUR AND SPIRAL GEARS

We carry in stock standard hobs for all makes of hobbing machines, both ground and unground. We recommend ground hobs. These hobs can be used for both spur and spiral gears. The right hand hob will cut both right and left hand spiral gears, but we recommend right hand hob for right hand spiral and left hand hob for left hand spiral.

When ordering, specify make of Hobbing Machine, Pitch, Size of Hole and Keyway, Pressure Angle, Single or Multiple Threads, Right or Left Hand, Ground or Formed, Carbon or High Speed Steel. Unless otherwise specified hobs will be furnished unground, 14½° pressure angle, single thread, right hand, high speed steel.

Continued on page 110

Hobs and Their Uses—continued



Notice to Users of Hobs

In 1929 we made and issued charts, as shown on the following pages, to our customers and users of Hobs.

Gear Generating Hob—Arbor Type
Gear Generating Hob—Shank Type
Worm Gear Hob—Arbor Type
Worm Gear Hob—Shank Type
Spline Shaft Hob

These charts merely required the filling in of dimensions and information called for and were found to be a convenience, saving time and correspondence. They became so popular we decided to incorporate them into this our latest catalog. The size of the charts is 8½″ by 11″.

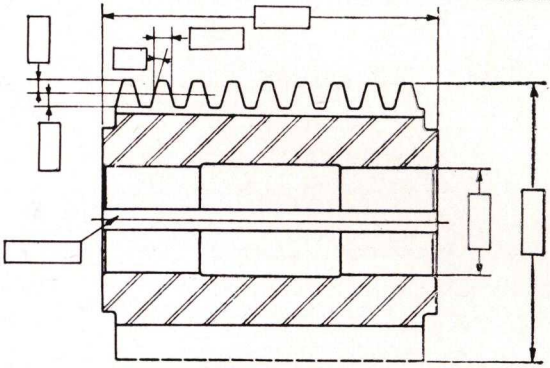
We will furnish any of these charts upon request.

For Charts see pages 112–116.

Gear Generating Hob

ARBOR TYPE

Size of Chart 8½" x 11"



GEAR GENERATING HOB

HIGH SPEED OR CARBON STEEL _____
PITCH (NORMAL OR LINEAR FIGURES) _____
NUMBER OF THREADS _____
RIGHT OR LEFT HAND THREADS _____
PRESSURE ANGLE _____
ROUGHING OR FINISHING _____
GROUND OR UNGROUND _____
TOPPING (YES OR NO) _____
DIAMETER _____
LENGTH _____
DIAMETER OF HOLE _____
KEYWAY _____
THICKNESS OF TOOTH "t" _____
DISTANCE ABOVE PITCH LINE ("s" ON HOB) _____
DISTANCE BELOW PITCH LINE ("s+f" ON HOB) _____
STRAIGHT OR SPIRAL FLUTES _____
RADIAL OR UNDERCUT _____
MATERIAL TO BE CUT _____
KIND OF GEARS (SPUR OR SPIRAL) _____

INFORMATION:- SEND BLUEPRINT OF WORK TO BE CUT WHEN POSSIBLE

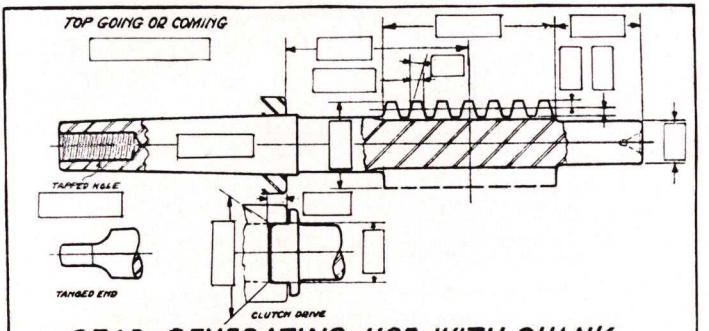
Notice to Users of Hobs see page 111.
Charts furnished upon request.

Continued on page 113

Gear Generating Hob

SHANK TYPE

Size of Chart 8½" x 11"



GEAR GENERATING HOB WITH SHANK

HIGH SPEED OR CARBON STEEL _____
PITCH (NORMAL OR LINEAR FIGURES) _____
NUMBER OF THREADS _____
RIGHT OR LEFT HAND THREADS _____
ROTATION (TOP GOING OR COMING) _____
PRESSURE ANGLE _____
ROUGHING OR FINISHING _____
GROUND OR UNGROUND _____
TOPPING (YES OR NO) _____
DIAMETER OF HOB PORTION _____
LENGTH OF HOB PORTION _____
THICKNESS OF TOOTH "t" _____
DISTANCE ABOVE PITCH LINE ("s" IN HOB) _____
DISTANCE BELOW PITCH LINE ("s+f" IN HOB) _____
STRAIGHT OR SPIRAL FLUTES _____
IF SPIRAL, RIGHT OR LEFT HAND _____
RADIAL OR UNDERCUT _____

LENGTH OF PILOT _____
DIAMETER OF PILOT _____
IS PILOT USED IN BEARING OR ON CENTERS _____
NUMBER OF SHANK _____
METHOD OF DRIVE (CLUTCH OR TAPER) _____
HAS SHANK TAPPED HOLE OR TANG _____
IF TAPPED HOLE, GIVE SIZE & THREAD _____
RIGHT OR LEFT HAND THREAD _____
IF CLUTCH DRIVE GIVE:-
WIDTH OF SLOT IN SPINDLE _____
DEPTH OF SLOT IN SPINDLE _____
DIAM. HOLE AT LARGE END OF SPINDLE _____
GIVE DISTANCE FROM END OF SPINDLE
TO CENTER OF HOB PORTION _____
MAKE OF MACHINE USED ON _____
MATERIAL TO BE CUT _____
KIND OF GEARS (SPUR OR SPIRAL) _____

INFORMATION:- SEND BLUEPRINT OF WORK TO BE CUT WHEN POSSIBLE.

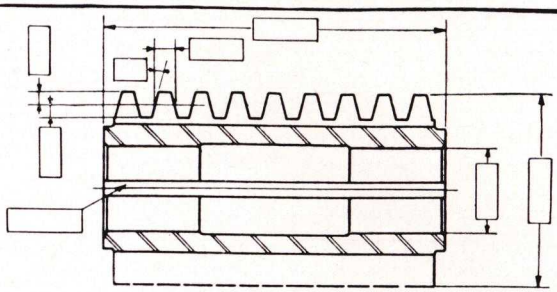
Notice to Users of Hobs see page 111.
Charts furnished upon request.

Continued on page 114

Worm Gear Hob

ARBOR TYPE

Size of Chart 8½″ x 11″



WORM GEAR HOB

HIGH SPEED OR CARBON STEEL _____
PITCH (LINEAR OR NORMAL FIGURES) _____
NUMBER OF THREADS _____
RIGHT OR LEFT HAND THREADS _____
PRESSURE ANGLE (LINEAR OR NORMAL) _____
ROUGHING OR FINISHING _____
GROUND OR UNGROUND _____
OUTSIDE DIAMETER OF WORM _____
LENGTH OF WORM OR NUMBER OF TEETH IN GEAR _____
(THIS TO DETERMINE LENGTH OF HOB)
DIAMETER OF HOLE _____
KEYWAY _____
THICKNESS OF TOOTH _____
DISTANCE ABOVE PITCH LINE _____
DISTANCE BELOW PITCH LINE _____
DOES HOB DRIVE WORK? _____
IF HOB DRIVES WORK (STRAIGHT OR SPIRAL FLUTES) _____
RADIAL OR UNDERCUT _____
MATERIAL TO BE CUT _____
MAKE OF MACHINE USED ON _____

INFORMATION :- SEND BLUEPRINT OF WORK TO BE CUT WHEN POSSIBLE.

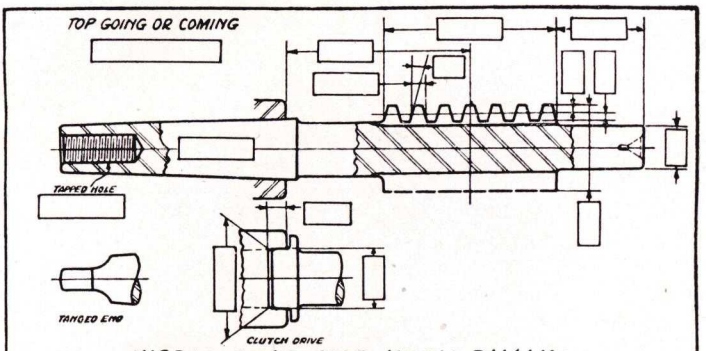
Notice to Users of Hobs see page 111.
Charts furnished upon request.

Continued on page 115

Worm Gear Hob

SHANK TYPE

Size of Chart 8½" x 11"



WORM GEAR HOB WITH SHANK

HIGH SPEED OR CARBON STEEL _____
PITCH (LINEAR OR NORMAL FIGURES) _____
NUMBER OF THREADS _____
RIGHT OR LEFT HAND THREADS _____
ROTATION (TOP GOING OR COMING) _____
PRESSURE ANGLE (LINEAR OR NORMAL) _____
ROUGHING OR FINISHING _____
GROUND OR UNGROUND _____
OUTSIDE DIAMETER OF WORM _____
LENGTH OF WORM OR NUMBER OF TEETH IN GEAR _____
(THIS TO DETERMINE LENGTH OF HOB PORTION)
THICKNESS OF TOOTH _____
DISTANCE ABOVE PITCH LINE _____
DISTANCE BELOW PITCH LINE _____
DOES HOB DRIVE WORK? _____
IF HOB DRIVES WORK (STRAIGHT OR SPIRAL FLUTES) _____
RADIAL OR UNDERCUT _____

LENGTH OF PILOT _____
DIAMETER OF PILOT _____
IS PILOT USED IN BEARING OR ON CENTERS _____
NUMBER OF SHANK _____
METHOD OF DRIVE (CLUTCH OR TAPER) _____
HAS SHANK TAPPED HOLE OR TANG? _____
IF TAPPED HOLE, GIVE SIZE & THREAD _____
RIGHT OR LEFT HAND THREAD _____
IF CLUTCH DRIVE GIVE:-
WIDTH OF SLOT IN SPINDLE _____
DEPTH OF SLOT IN SPINDLE _____
DIAMETER OF HOLE AT LARGE END OF SPINDLE _____
GIVE DISTANCE FROM END OF
SPINDLE TO CENTER OF HOB PORTION _____
MAKE OF MACHINE USED ON _____
MATERIAL TO BE CUT _____

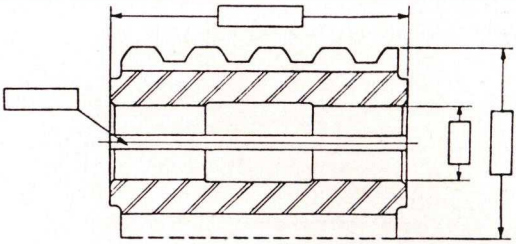
INFORMATION:- SEND BLUEPRINT OF WORK TO BE CUT WHEN POSSIBLE

Notice to Users of Hobs see page 111.
Charts furnished upon request.

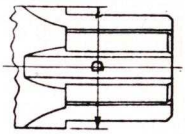
Continued on page 116

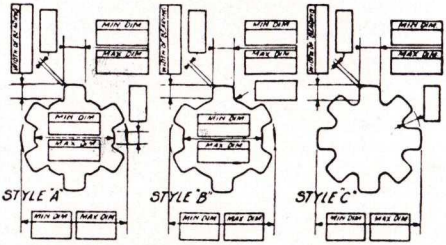
Spline Shaft Hob

Size of Chart 8½" x 11"



DOES SHAFT HAVE SHOULDER WITH CUT RUNNING INTO IT AS SHOWN BELOW? IF SO, GIVE DIAMETER "D"





SPLINE SHAFT HOB

HIGH SPEED OR CARBON STEEL _____
SINGLE OR DOUBLE THREADS _____
RIGHT OR LEFT HAND THREADS _____
ROUGHING OR FINISHING _____
GROUND OR UNGROUND _____
TOPPING (YES OR NO) _____
DIAMETER _____
LENGTH _____
DIAMETER OF HOLE _____

STRAIGHT OR SPIRAL FLUTES _____
RADIAL OR UNDERCUT _____
MATERIAL TO BE CUT _____
STYLE OF SHAFT "A" "B" OR "C" _____
NUMBER OF SPLINES _____

NOTE: ARE DIMENSIONS OF SHAFT GIVEN AS FINISH DIM. OR HOBBING DIM.? _____

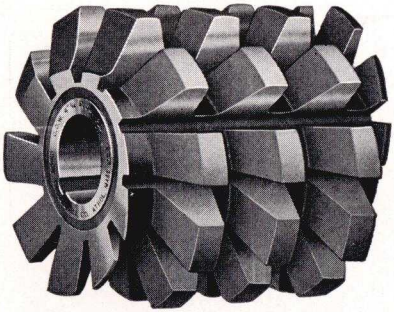
INFORMATION:- SEND BLUE PRINT OF WORK TO BE CUT WHEN POSSIBLE.

Notice to Users of Hobs see page 111.
Charts furnished upon request.

Spur Gear Hobs

14½ DEGREES PRESSURE ANGLE

HIGH SPEED STEEL



Spur Gear Hobs are carried in stock, ground and unground, right and left hand, single thread, 14½° pressure angle, high speed steel.

Unless otherwise specified, Hobs will be furnished unground, right hand, single thread, 14½° pressure angle, high speed steel.

Unground Hobs No. U12

Diametral Pitch	Dimensions—Inches				Price Each High Speed Steel
	Diameter	Length	Size Hole	Size Keyway	
1	10¾	15	2½	⅝ x 5/16	$775.20
1¼	8¾	12	2	½ x ¼	457.30
1½	8	10	2	½ x ¼	333.80
1¾	7¼	9	2	½ x ¼	260.70
2	5¾	8	1½	⅜ x 3/16	168.70
2¼	5¼	7½	1½	⅜ x 3/16	140.50
2½	5	7	1½	⅜ x 3/16	123.20
2¾	4¾	6	1½	⅜ x 3/16	99.10

Carbon Steel Hobs are special. Prices on application.

Interchangeable Hobs for Spur and Spiral Gears see page 121.

For Hob Grinding Machine see pages 286–287.

Continued on page 118

Spur Gear Hobs—continued

14½ DEGREES PRESSURE ANGLE

HIGH SPEED STEEL

WITH 1¼ INCH HOLE

Keyway ¼ x ⅛

Unground Hobs No. U14 — Ground Hobs No. G50

Diametral Pitch	Dimensions—Inches		Price Each High Speed Steel	
	Diameter	Length	Unground	Ground
3	4½	5	$77.40	$104.80
3½	4¼	4¾	68.60	93.10
4	4	4	53.80	74.30
5	3½	3½	40.60	57.40
6	3¼	3¼	34.80	49.90
7	3	3	29.50	42.90
8	3	3	29.50	42.90
9	3	3	29.50	42.90
10	2¾	2¾	27.70	39.60
12	2¾	2¾	29.10	41.00
14	2½	2½	27.00	40.60
16	2½	2½	27.00	40.60
18	2½	2½	28.30	45.10
20	2½	2½	28.30	45.10
22	2½	2	26.00	44.00
24	2½	2	27.10	45.10
26	2½	2	27.10	45.10
28	2½	2	27.10	48.00
30	2½	2	29.50	50.40

WITH ¾ INCH HOLE

Keyway ⅛ x 1/16

Unground Hobs No. U16 — Ground Hobs No. G60

Diametral Pitch	Dimension—Inches		Price Each High Speed Steel	
	Diameter	Length	Unground	Ground
*10	2 1/16	2	$22.00	$30.90
12	2	2	22.50	31.10
14	1⅞	1⅞	21.30	31.50
16	1⅞	1⅞	21.30	31.50
18	1⅞	1⅞	22.30	34.90
20	1⅞	1⅞	22.30	34.90
22	1⅞	1⅞	22.30	37.30
24	1⅞	1⅞	23.30	38.30
26	1⅞	1⅞	23.30	38.30

*This pitch is beyond the rated capacity of the B-C No. 2 Hobbing Machine.

Interchangeable Hobs for Spur and Spiral Gears see page 121.
For Hob Grinding Machine see pages 286–287.

List continued on page 119

Spur Gear Hobs—continued

14½ DEGREES PRESSURE ANGLE

HIGH SPEED STEEL

WITH ¾ INCH HOLE Keyway ⅛ x 1/16

Unground Hobs No. U16 Ground Hobs No. G60

Diametral Pitch	Dimensions—Inches		Price Each High Speed Steel	
	Diameter	Length	Unground	Ground
28	1⅞	1⅞	$23.30	$40.70
30	1⅞	1½	23.10	38.80
32	1⅞	1½	23.10	40.90
34	1⅞	1½	24.10	41.90
36	1⅞	1½	24.10	44.00
38	1⅞	1½	24.10	44.00
40	1⅞	1½	25.90	45.90
42	1⅞	1½	25.90	48.60
44	1⅞	1½	25.90	48.60
46	1⅞	1½	27.80	53.10
48	1⅞	1½	27.80	53.10
50	1⅞	1½	27.80	56.10

WITH ½ INCH HOLE Keyway ⅛ x 1/16

Unground Hobs No. U18 Ground Hobs No. G70

Diametral Pitch	Dimensions—Inches		Price Each High Speed Steel	
	Diameter	Length	Unground	Ground
24	1¼	1¼	$16.30	$26.30
26	1¼	1¼	16.30	26.30
28	1¼	1¼	16.30	27.90
30	1⅛	1⅛	16.10	26.60
32	1⅛	1⅛	16.10	28.00
34	1⅛	1⅛	16.80	28.70
36	1⅛	1⅛	16.80	30.10
38	1⅛	1⅛	16.80	30.10
40	1⅛	1⅛	18.10	31.40
42	1⅛	1⅛	18.10	33.20
44	1⅛	1⅛	18.10	33.20
46	1⅛	1⅛	19.40	36.30
48	1⅛	1⅛	19.40	36.30
50	1⅛	1⅛	19.40	38.30

Interchangeable Hobs for Spur and Spiral Gears see page 121.
For Hob Grinding Machine see pages 286–287.

Stub Tooth Gear Hobs

20 DEGREES PRESSURE ANGLE

HIGH SPEED STEEL

Stub Tooth Gear Hobs 20° pressure angle produce a shorter, wider and stronger gear tooth than the standard 14½° pressure angle tooth form.

In the Stub Tooth system of gears the characteristics of two pitches are combined in a single hob. For Example:—On a 4-5 D. P. Hob the pitch (4) is used in figuring the circular pitch, tooth thickness and the width of space, and the pitch (5) for figuring the addendum and dedendum.

The principal advantage of this form of gearing is the increased strength of gear tooth.

This type of gear is extensively used in automotive transmissions.

Unground Hobs No. U20 — Ground Hobs No. G80

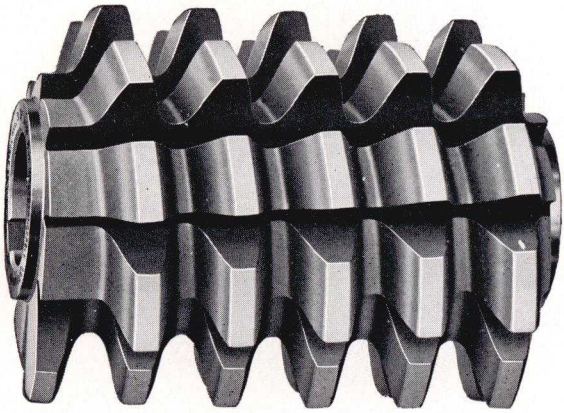
Diametral Pitch	Dimensions—Inches				Price Each High Speed Steel	
	Diameter	Length	Size Hole	Size Keyway	Unground	Ground
3–4	4	4	1¼	¼ x ⅛	$53.80	$76.80
4–5	3½	3½	1¼	¼ x ⅛	40.60	58.50
5–7	3¼	3¼	1¼	¼ x ⅛	34.80	50.40
6–8	3	3	1¼	¼ x ⅛	29.50	43.40
7–9	3	3	1¼	¼ x ⅛	29.50	42.90
8–10	2¾	2¾	1¼	¼ x ⅛	27.70	40.00
9–11	2¾	2¾	1¼	¼ x ⅛	27.70	40.00
10–12	2	2	¾	⅛ x 1/16	21.40	30.00
10–12	2¾	2¾	1¼	¼ x ⅛	27.70	39.60
12–14	2	2	¾	⅛ x 1/16	22.50	31.10
12–14	2½	2½	1¼	¼ x ⅛	27.00	37.80

Carbon Steel Stub Tooth Gear Hobs are special. Prices on application.

For Hob Grinding Machine see pages 286–287.

Hobs and Their Uses—continued

INTERCHANGEABLE HOBS FOR SPUR AND SPIRAL GEARS



To meet the demand for hobs which will produce gears to run with gears cut with rotary gear cutters, we carry in stock Interchangeable Hobs.

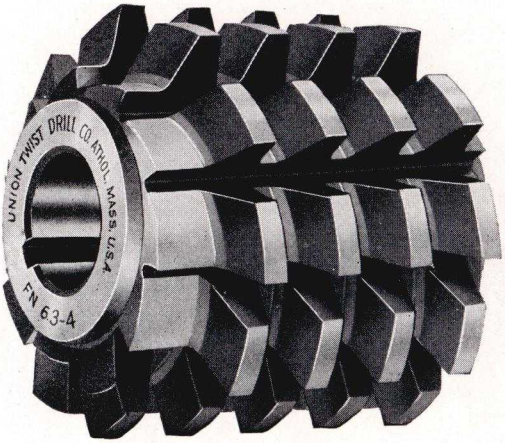
When ordering, specify whether interchangeable hobs or standard hobs are desired, Ground or Unground, Diameter, Pitch, Size of Hole, Size of Keyway. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

Prices on application.

Continued on page 122

Hobs and Their Uses—continued

WORM WHEEL HOBS



Worm wheel hobs are furnished ground and unground and are generally made with a hole to fit some standard arbor if the diameter is sufficiently large to permit of a hole large enough to drive the particular pitch of hob wanted. If the hole is too small, the hob should be made with a solid shank.

It is our practice to make the outside diameter of worm gear hobs larger than the worm by an amount equal to two standard clearances for the pitch given, plus an added allowance for sharpening, so the hob, when new, will have pitch diameter slightly larger than the worm and will give a reasonable amount of service before it is reduced by

Continued on page 123

Hobs and Their Uses—continued

sharpening to a pitch diameter less than that of the worm. The hob thread should be practically the same shape as the worm thread. It is therefore advisable to furnish a sample worm which is to engage with the worm gear cut with hob ordered. Worms are cut with double angle cutters, formed cutters, and shaped with threading tools, each likely to produce a different form of worm thread. It is therefore essential if the best results are desired to furnish a sample worm with order. Hobs whose threads make an angle of 82 degrees or more with axis are furnished with straight gashes. Hobs with thread angles less than 82 degrees furnished with spiral gashes at right angles to the thread unless otherwise specified.

When ordering—

Specify hole and keyway preferred, or size and length of straight or taper shank.

Send drawing showing direction shank hob should revolve.

Specify—

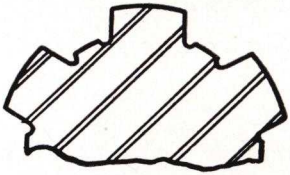
Pitch.
Outside diameter of worm and length of worm.
Number of teeth in worm wheel.
Circular pitch or lead of worm.
Single or multiple thread.
Pressure angle.
Right or left hand worm.
Ground or formed.
Straight or spiral gash.
Carbon or high speed steel.
Whether hob is required to drive the work.
Material to be cut.

Prices on application.

Continued on page 124

Hobs and Their Uses—continued

HOBS FOR SPLINE SHAFTS



STYLE "A" WITH CLEARANCE LUGS

Spline shafts can be produced rapidly and accurately by the hobbing method. We recommend ground hobs for finishing spline shafts to close limits.

When ordering, give Diameter of Hole and Size of Keyway, Outside Diameter of Shaft, Number of Splines, Width of Spline and Bottom Diameter. Specify length of straight side of spline. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

Hobs are furnished in three styles, as shown: "A" with clearance lugs to generate a recess at the base of spline; "B" without clearance lugs; "C" having a radius at the bottom between the splines. When giving style and shaft dimensions, specify limits or tolerances allowable.

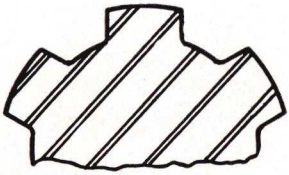
Roughing hobs can be furnished to leave suitable grinding allowance on bottom diameter and width of spline.

Prices on application.

Continued on page 125

Hobs and Their Uses—continued

HOBS FOR SPLINE SHAFTS



STYLE "B" WITHOUT CLEARANCE LUGS

When ordering give information requested on page 124.

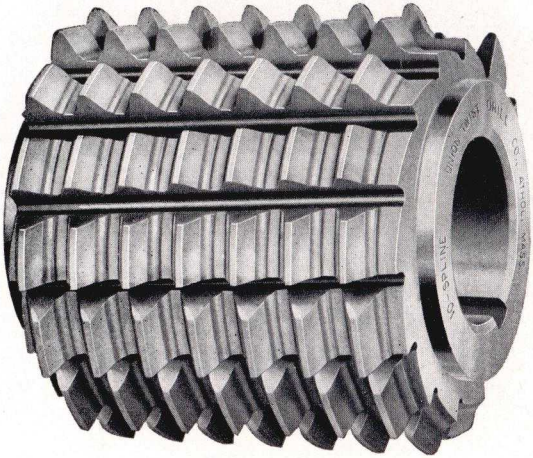
Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

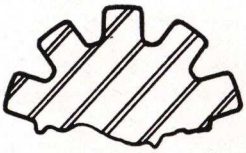
Prices on application.

Continued on page 126

Hobs and Their Uses—continued

HOBS FOR SPLINE SHAFTS





STYLE "C" HOBS FOR SPLINE SHAFT FOR 10 OR MORE SPLINES

Note Radius at Base of Spline

When ordering give information requested on page 124.

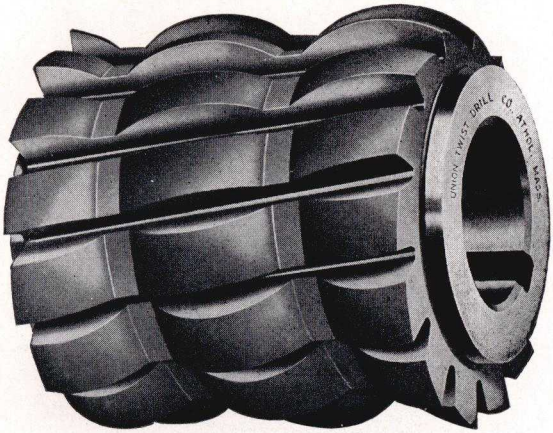
Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

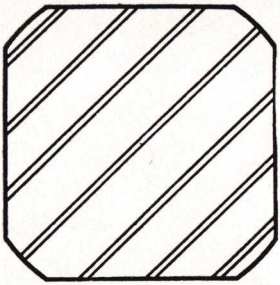
Prices on application.

Continued on page 127

Hobs and Their Uses—continued

HOBS FOR HOBBING SQUARE SHAFTS





We are prepared to furnish hobs for hobbing square shafts.

When ordering we should know if the corner of shafts are rounded by turning before hobbing. Also require distance across flats, limits allowed, Size of Hole and Keyway and material to be cut.

Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

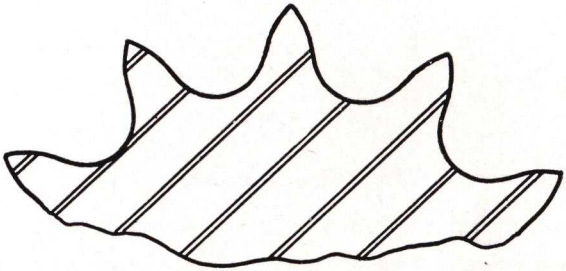
Form grinding for this type of hob is unnecessary.

Prices on application.

Continued on page 128

Hobs and Their Uses—continued

ROLLER CHAIN SPROCKET HOBS



Sprocket hobs, unless otherwise specified, are furnished right hand, American Standard form. One hob will cut all numbers of teeth from 6 teeth and larger.

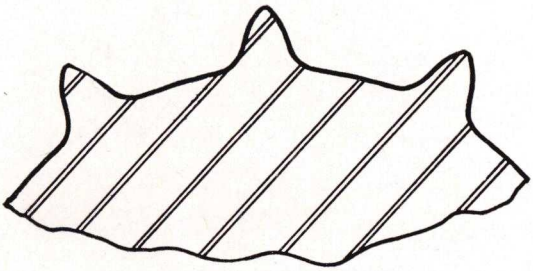
When ordering sprocket hobs, give Diameter of Hole, Size of Keyway, Pitch of Chain, Size of Roller, Number of Teeth in Sprocket and material to be cut. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

Prices on application.

Continued on page 129

Hobs and Their Uses—continued

BLOCK CHAIN SPROCKET HOBS



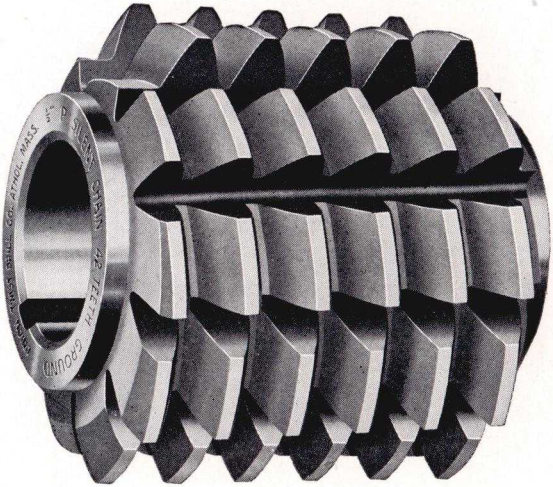
When ordering give Diameter of Hole, Size of Keyway, Pitch of Chain, Number of Teeth in Sprocket and material to be cut. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

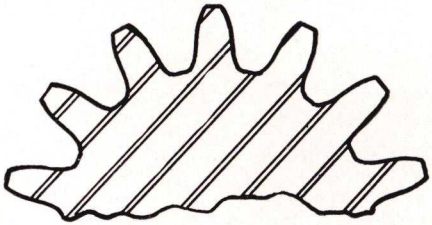
Prices on application.

Continued on page 130

Hobs and Their Uses—continued

SILENT CHAIN SPROCKET HOBS





Sprocket hobs can be furnished for any standard make of silent chain. These hobs are generally furnished for an exact number of teeth. A slight range of teeth may be cut, depending on the accuracy desired. We recommend the use of ground hobs for silent chain sprockets.

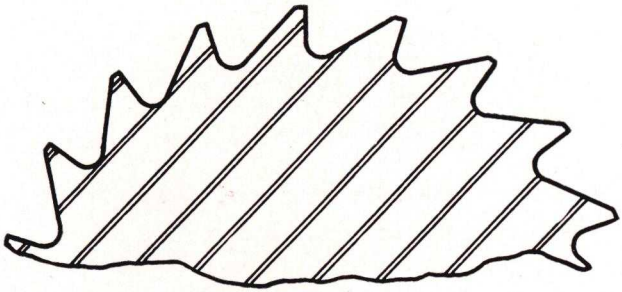
When ordering, give Size of Hole and Keyway, Pitch and make of Chain, Number of Teeth in Sprocket and Make of Hobbing Machine used, and also whether Right Hand or Left Hand, kind of material. Furnish sample when possible. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

Prices on application.

Continued on page 131

Hobs and Their Uses—continued

HOBS FOR HOBBING RATCHETS

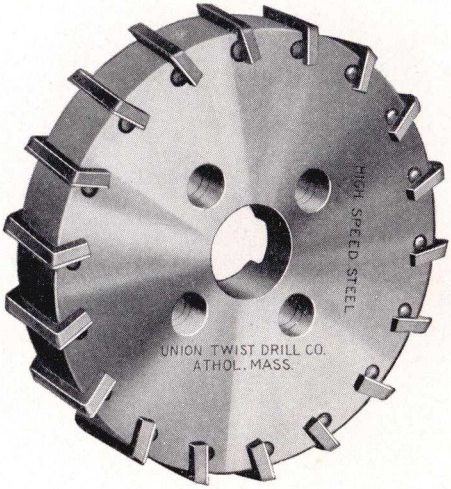


Hobs can be furnished for any shape of ratchet tooth whose face is not undercut.

When ordering specify Outside Diameter, Number of Teeth and Shape of Ratchet Tooth wanted. Also the type of material on which hob is to be used. Unless otherwise specified these Hobs will be furnished made of High Speed Steel.

Prices on application.

Inserted Blade Cutters



In cases where large cutters are required, Inserted Blade Cutters are often found economical and can be furnished for a wide variety of special milling operations.

These cutters have high speed steel blades. Bodies are of heat treated steel and the blades are securely locked in position.

After repeated grindings the blades can be moved to compensate for wear and when worn out the blades can be easily and quickly replaced.

Continued on page 133

Inserted Blade Cutters—continued

The method of holding blades firmly in the body of the cutter varies according to the experience of the maker. We use various methods depending on the size and type of cutter.

We also make what are called Serrated Blade Cutters (see pages 138–140 for illustrations). The blades are firmly locked in position.

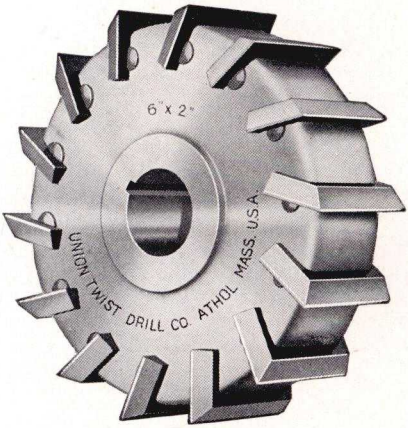
On Slab Milling Cutters, shown on page 142, a bushing is used. It is slightly concaved and when driven against the tooth a wedging action holds it firmly in position.

Drawing on page 145 shows blade set on an angle and cutting face milled spiral. Cutting face has constant rake.

Continued on page 134

Side Milling Cutters

WITH HIGH SPEED STEEL INSERTED BLADES



Heat Treated Bodies

Our method of securing the blades holds them positively in position and they can be easily adjusted or replaced when worn.

A most economical type of cutter for heavy or large work.

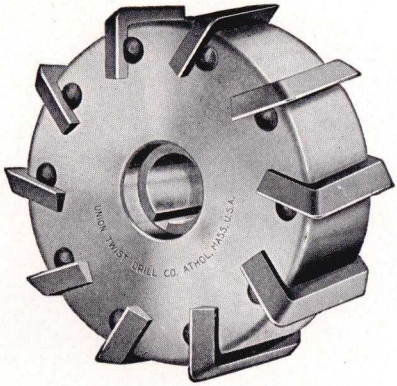
The following sizes are carried in stock:

Catalog No.	Dimensions—Inches			Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Width Face	Size Hole		
C80	6	2	1¼	$55.50	$1 75
C81	7	2	1¼	61.80	1.75
C82	7	2	1¾	61.80	1.75
C83	8	2	1½	69.50	1.75
C84	8	2	2	69.50	1.75
C85	9	2	1½	77.80	1.75
C86	10	2	1½	86.65	1.75

Sizes not listed are made to order. Prices quoted on application.
For Keyway see page 8.

Face Milling Cutters

WITH HIGH SPEED STEEL INSERTED BLADES AND TAPER HOLES



Heat Treated Bodies

These Cutters have tapering holes which are provided with a keyway for driving and cutters are held securely on arbor by means of a screw in the end.

These Face Milling Cutters are furnished either Right or Left Hand. In ordering specify which is required.

Catalog No.	Dimensions—Inches		B. & S. Taper Hole No.	Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Length of Blades			
C50	5½	2¼	10	$ 64.10	$1.90
C51	5½	2¼	12	65.10	1.90
C52	6½	2¼	10	71.10	1.90
C53	6½	2¼	12	72.10	1.90
C54	7½	2¼	12	81.25	1.90
C55	8½	2¼	12	91.15	1.90
C56	9½	2¼	12	101.75	1.90

Sizes not listed are made to order. Prices quoted on application.
For Arbors see page 266.

Coarse Tooth Face Milling Cutters

WITH HIGH SPEED STEEL INSERTED BLADES FOR FLANGED SPINDLE

For use on Milling Machines having the Standardized Spindle End.

Heat Treated Bodies

These Coarse Tooth Face Milling Cutters have strong blades of High Speed Steel firmly set into and supported by massive steel bodies. The blades do not extend through.

The back plate carries adjusting screws, which are set against the blades, and support them against the end pressure resulting from heavy cutting. These screws also provide means for adjusting the blades endwise when wear and repeated grindings have made this necessary.

The cutting edges on both the face and periphery have liberal rake.

When sharpening these Cutters care should be taken that the rounding of the corners will never exceed 1/8 inch radius.

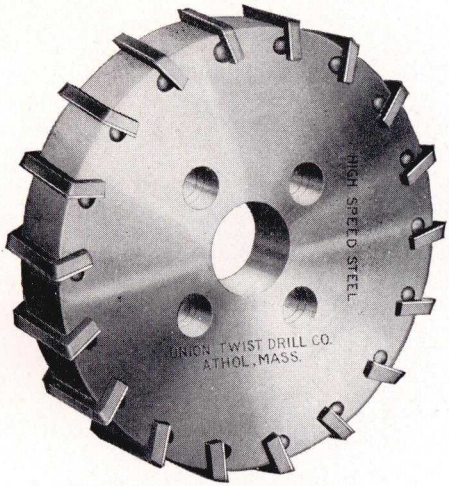
FOR HIGH POWER MILLERS

Catalog No.	Dimensions—Inches		Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Size of Blades		
C30	8	1 1/4 x 1/2 x 3 11/32	$101.25	$2.80
C31	10	1 1/4 x 1/2 x 3 11/32	127.50	2.80
C32	12	1 1/4 x 1/2 x 3 11/32	149.25	2.80
C33	14	1 1/4 x 1/2 x 3 11/32	176.20	2.80
C34	16	1 1/4 x 1/2 x 3 11/32	205.00	2.80

Right and left hand cutters considered standard.

Face Milling Cutters

WITH HIGH SPEED STEEL INSERTED BLADES FOR FLANGED SPINDLE



Heat Treated Bodies

Catalog No.	Dimensions—Inches		Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Length of Blades		
C40	7½	2⅜	$ 73.75	$1.90
C41	8½	2⅜	82.70	1.90
C42	9½	2⅜	92.80	1.90
C43	10½	2⅜	101.70	1.90
C44	12	2⅜	114.50	1.90
C45	14	2⅜	135.15	1.90
*C46	16	2⅜	157.00	1.90
*C47	18	2⅜	199.00	1.90

*Made on special order only.

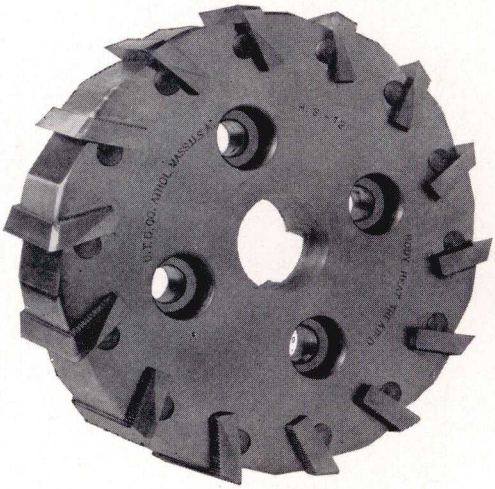
Right and left hand cutters considered standard.

Sizes up to and including 14 inches diameter in stock.

For Face Milling Cutters with Serrated Blades see page 138.

Face Milling Cutters

WITH HIGH SPEED STEEL SERRATED BLADES FOR FLANGED SPINDLE



Heat Treated Bodies

For use on Milling Machines having the Standardized Spindle End.

These Face Milling Cutters are furnished either Right or Left Hand. In ordering specify which is required.

Standard Type

Catalog No.	Dimensions—Inches		No. of Blades in Mill	Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Length of Blades			
C10	8	2 3/8	18	Prices on Application	Prices on Application
C11	9	2 3/8	20		
C12	10	2 3/8	22		
C13	12	2 3/8	26		
C14	14	2 3/8	28		
C15	16	2 3/8	30		

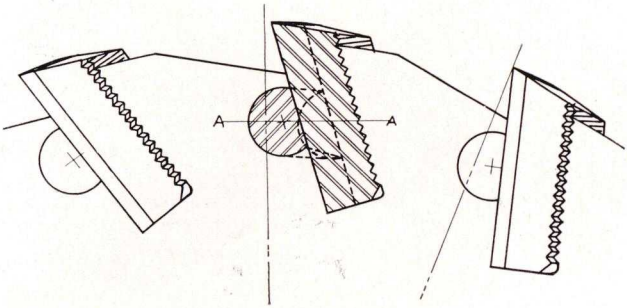
Coarse Tooth Type

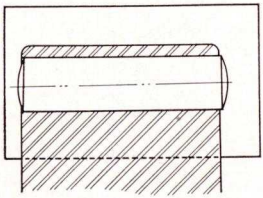
Catalog No.	Dimensions—Inches		No. of Blades in Mill	Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diameter	Length of Blades			
C20	10	2 3/8	16	Prices on Application	Prices on Application
C21	12	2 3/8	20		
C22	14	2 3/8	22		
C23	16	2 3/8	24		

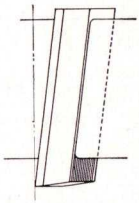
For Shell End Mills with Serrated Blades see page 140.
For drawing showing Serrated Blades see page 139.

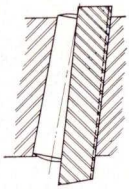
Cutters with Serrated Blades

The drawing shows construction of Serrated Blade Cutters.









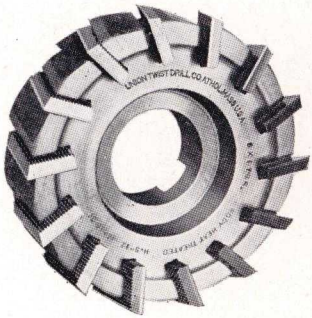
SECTION A-A

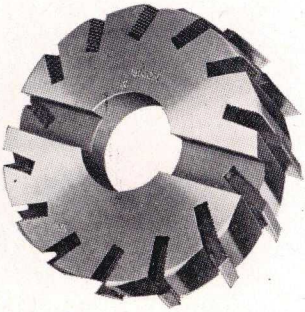
For Shell End Mills with Serrated Blades see page 140.

For Face Milling Cutters with Serrated Blades see page 138.

Shell End Mills

WITH HIGH SPEED STEEL SERRATED BLADES





Heat Treated Bodies

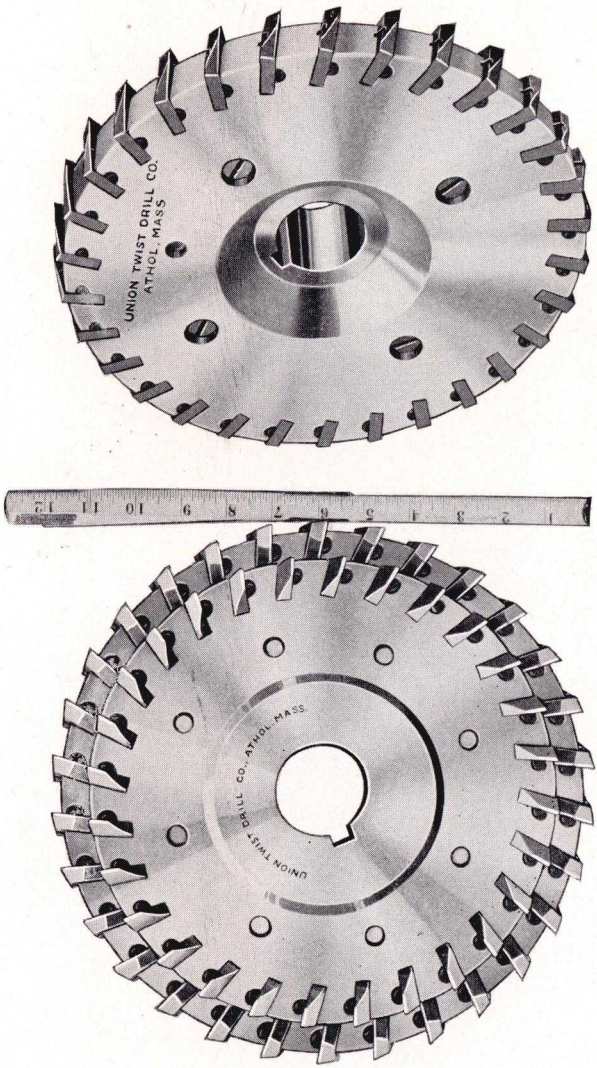
These Mills are furnished either Right or Left Hand.

Catalog No.	Dimensions—Inches			No. of Blades in Mill	Price Each Complete with High Speed Steel Blades	Price Each High Speed Steel Blades
	Diam.	Width Face	Size Hole			
C70	5	1¾	1½	12	Prices on Application	Prices on Application
C71	5½	1¾	2	14		
C72	6	1⅞	2	14		
C73	7	1⅞	2	16		

For Standard Shell End Mills see page 45.

For Shell End Mill Arbors and Collet Adapters see pages 267–269.

For drawing showing Serrated Blades see page 139.

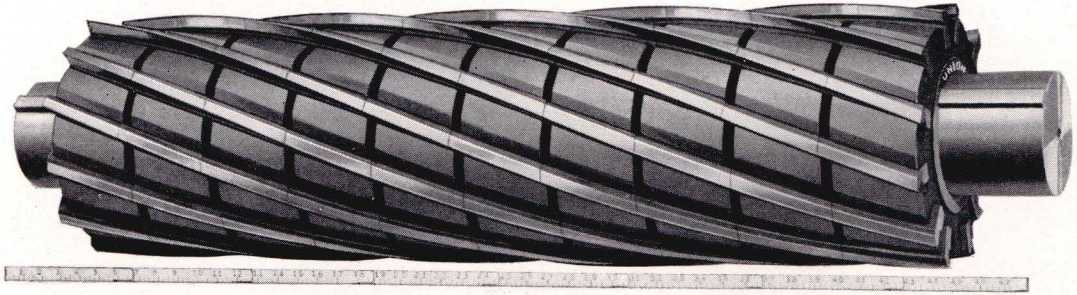


A GANG OF SPECIAL INSERTED BLADE SIDE MILLING CUTTERS

Designed for a straddle milling operation
Diameters 10⅜″ and 12″

Slab Milling Cutters

HEAT TREATED BODIES AND HIGH SPEED STEEL INSERTED BLADES



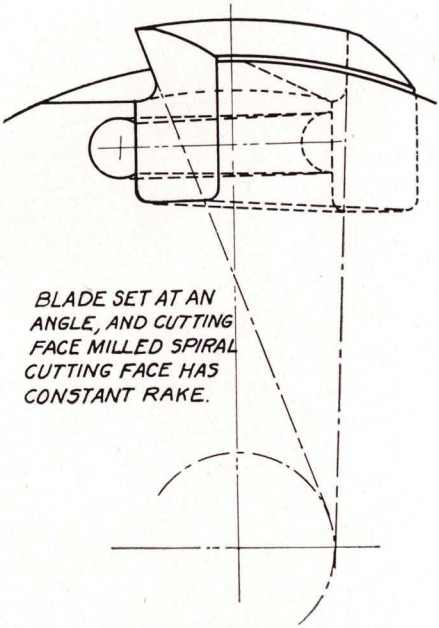
This Slabbing Cutter is of a type to give the same shearing cut as a Solid Spiral Milling Cutter. Made up in sections for various lengths. Blades can be easily replaced when worn. Particularly adapted to Slab Milling.

For drawing showing End of Blade see page 143.

Prices on application.

Slab Milling Cutter Blade

On Slabbing Cutters shown on page 142 we use the straight pin flatted method of holding blades in position.



The drawing shows end of blade set at an angle and cutting face milled spiral. Cutting face has constant rake.

UNION

"THE

TOOLS

YOU BUY

AGAIN"

Shaped Profile and Formed Cutters for the Production of Duplicate Parts

There is a difference between a Shaped Profile Cutter and Formed Cutter. A Shaped Profile Cutter or gang of Cutters is made to produce some special shape and made with the profile type of teeth. In repeated sharpening the diameter is materially reduced and the life of cutter or cutters is therefore shortened.

Formed Cutters, as the name implies, are made to a certain outline or shape for the production of pieces or parts which shall be duplicates, regardless of the number produced. The form or outline is not changed in sharpening as Formed Cutters are ground on the face of tooth, and repeated sharpenings when properly done make no change in the form or outline of cutter, so every piece milled during the life of the cutter will be a duplicate.

Formed Cutters are sometimes employed in a gang with Profile Cutters.

When extreme accuracy is required—accuracy beyond commercial limits—we are prepared in most cases, to grind Formed Cutters to much closer limits.

Formed Cutters were developed about 1864.

Cutters should be kept sharp.

For machines and fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

On the following pages, we show a few of the irregular outlines which can be produced by Formed Cutters.

Continued on page 146

Formed Cutters—continued

SUGGESTIONS IN ORDERING

When ordering formed cutters perhaps the following remarks will be helpful as they cover important points.

In ordering always send a drawing with all dimensions given and indicate the direction of revolution of cutter, that is, whether bottom is "going" or "coming." Also send a templet if possible.

We should also know under what conditions and on what material a cutter is to be used. Having such knowledge it is possible in many cases to better adapt the cutter for that particular use than if it were made to suit general conditions.

Where the limits within which a cutter must be made are confined we should know just what amount of variation is allowable.

To illustrate this point we would refer to the following sketches.

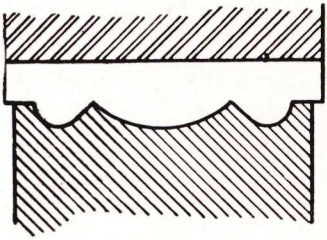


Fig. 1

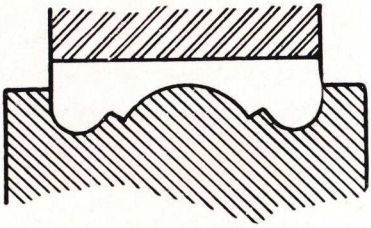


Fig. 2

Fig. 1 shows a cutter which extends beyond the work on both sides. It is not important that the cutter should be the exact thickness of the work, in fact, it is desirable to have it overlap as sketch shows, yet we should have definite advice.

Fig. 2 shows a cutter which is not so wide as the work and mills only the central portion. In this case the total width of cutter is important. The form should be made in the center of the cutter and we should know how many thousandths can be allowed over or under the exact width of cut.

Continued on page 147

Formed Cutters—continued

In the absence of instructions we must delay the order to make inquiries or assume that our ideas of the requirements are correct. We should not be left to assume, as it is possible that the indications might be such as would lead us to put the same amount of work on Fig. 1 as on Fig. 2, whereas it would not be necessary. On the other hand, we might, without knowing all the conditions, assume that the limits on Fig. 2 were unimportant, and neglect to make the form central, and might allow too wide a variation in the width.

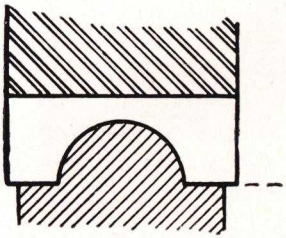


Fig. 3

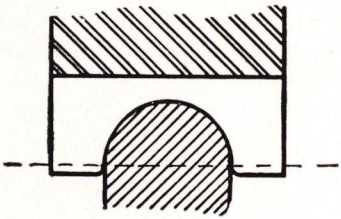


Fig. 4

Figures 3 and 4 will illustrate other points. Fig. 3 is a concave cutter for milling a half circle and the inside corners next the circle must be sharp and square. These corners dull and wear away more quickly than any other portion of the cutter, but as no provision can be made to overcome this there is no alternative except to use the cutter carefully and grind it frequently, and before the corners show any appreciable wear. If the grinding is delayed after the cutter becomes dull it will wear away very rapidly, and if not ruined, will at least need so much grinding as to cause considerable waste.

Fig. 4 is a concave cutter which cuts somewhat deeper than a half circle. In this case the sharp corner as in Fig. 3 is not necessary, and it can be rounded slightly as shown. This saves the cutter to a great extent as the rounding corner will not dull so quickly and consequently adds to the life of the cutter.

Continued on page 148

Formed Cutters—continued

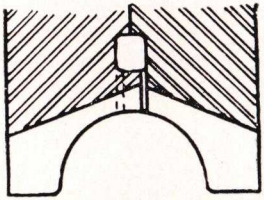


Fig. 5

Fig. 5 is a concave cutter made in two parts interlocked at the center. We think it is quite generally understood that a concave cutter, particularly when it cuts deeper than the half circle, has little or no cutting clearance on the sides of circle near points of teeth, for the reason that this portion is so nearly perpendicular to the cutter arbor.

Where the nature of the work will permit, it is of advantage to make cutter in two parts as shown, as this will allow each part to be given a side clearance, thus making it cut freely.

In sharpening such cutters the total width of the circle milled will be increased slightly on account of the side clearance, but cutters can be readily adjusted to the original or true width of circle by simply reducing the packing between cutters the required amount.

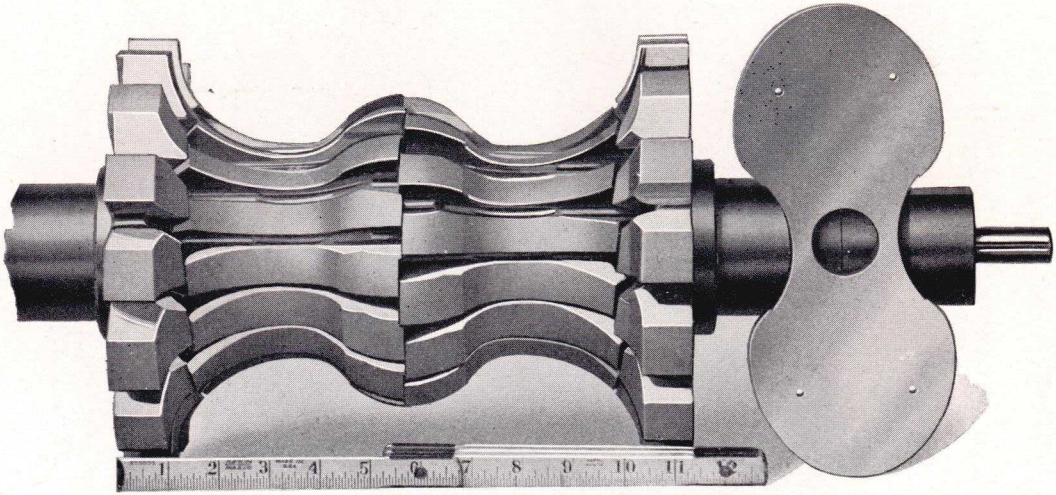
These are only a few instances but will serve to illustrate some of the questions which arise when an order is not definite.

In many cases it is possible to save much delay and useless expense by giving careful consideration to the requirements and the instructions concerning same in the order.

Continued on page 149

Interlocking Formed Cutter—Four Parts

CARBON AND HIGH SPEED STEEL



We are prepared to design and manufacture Formed Cutters for all purposes.

For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

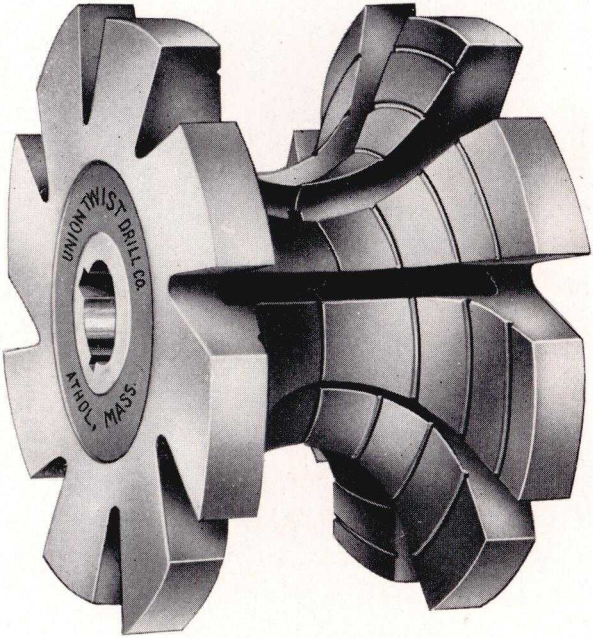
For Radial Grinding Gauge see page 278.

Continued on page 150

Formed Cutters—continued

For the Production of Duplicate Part

CARBON AND HIGH SPEED STEEL



For Radial Grinding Guage see page 278.

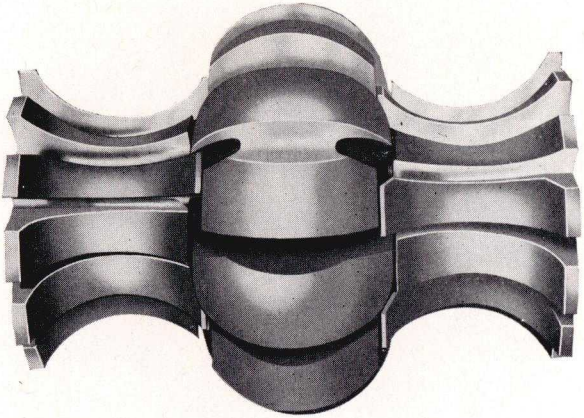
For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 151

Formed Cutters — continued

For the Production of Duplicate Part

CARBON AND HIGH SPEED STEEL



For Radial Grinding Guage see page 278.

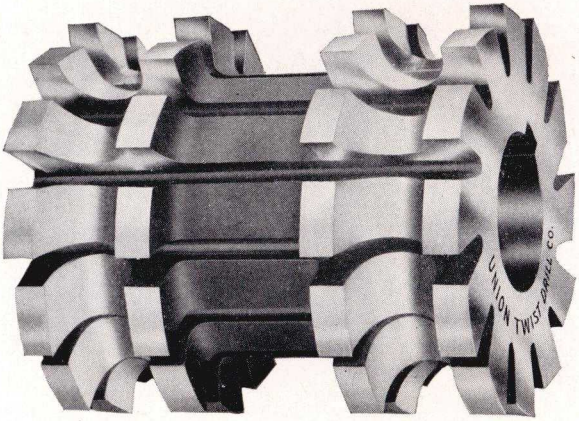
For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 152

Formed Cutters — continued

For the Production of Duplicate Part

CARBON AND HIGH SPEED STEEL



For Radial Grinding Guage see page 278.

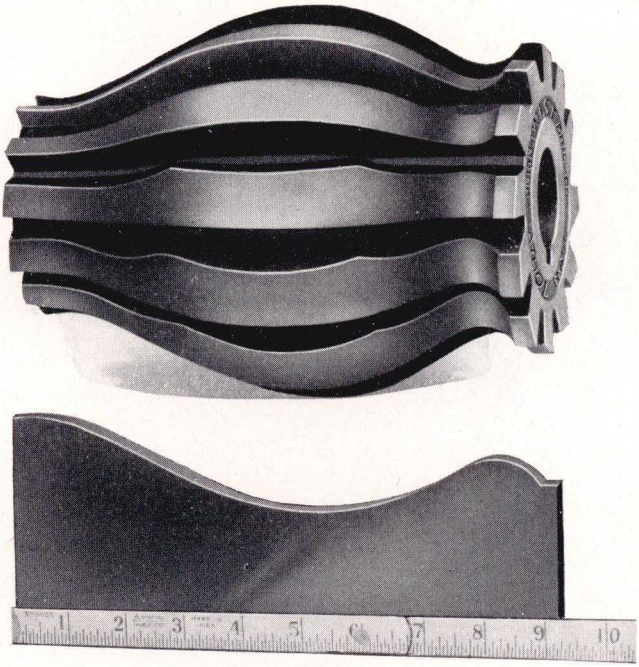
For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 153

Formed Cutters—continued

For the Production of Duplicate Parts

CARBON AND HIGH SPEED STEEL



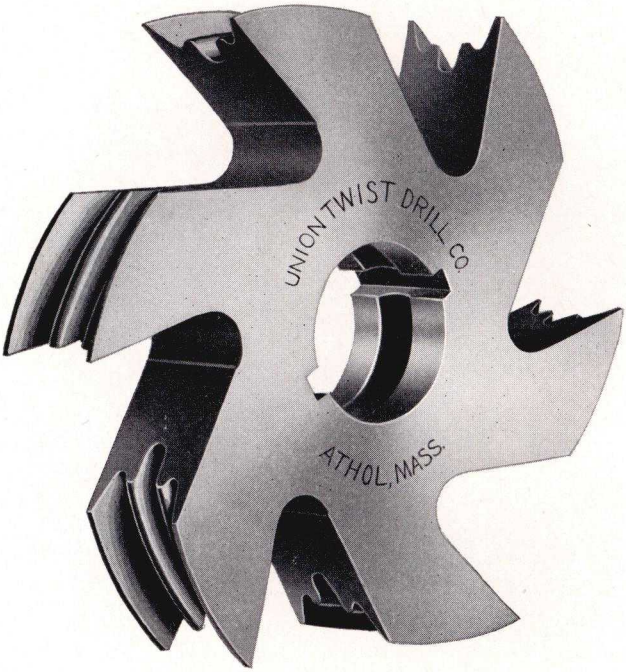
For Radial Grinding Gauge see page 278.

For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 154

Formed Cutters for Wood Working

CARBON AND HIGH SPEED STEEL



Various operations in producing odd shapes on wooden parts can be economically performed with cutters similar to illustration.

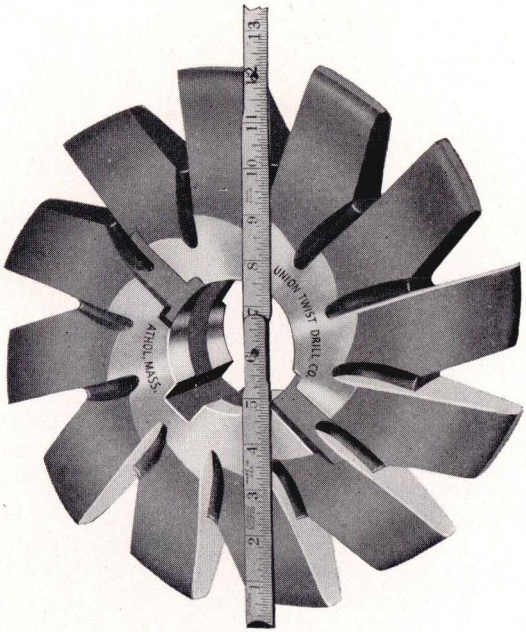
This type of cutter maintains its outline, producing uniform pieces.

Continued on page 155

Formed Cutters—continued

For the Production of Duplicate Parts

CARBON AND HIGH SPEED STEEL



For Radial Grinding Gauge see page 278.

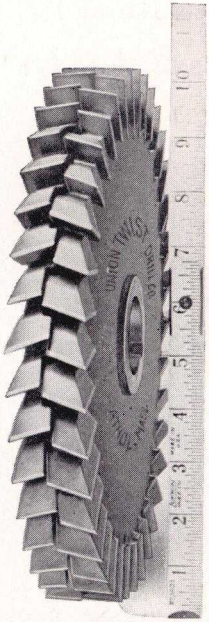
For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 156

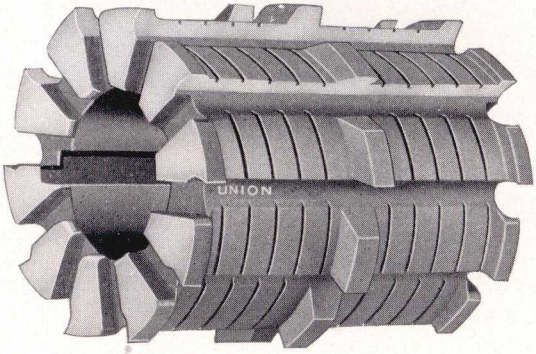
Formed and Profile Cutters—continued

CARBON AND HIGH SPEED STEEL

PROFILE TYPE

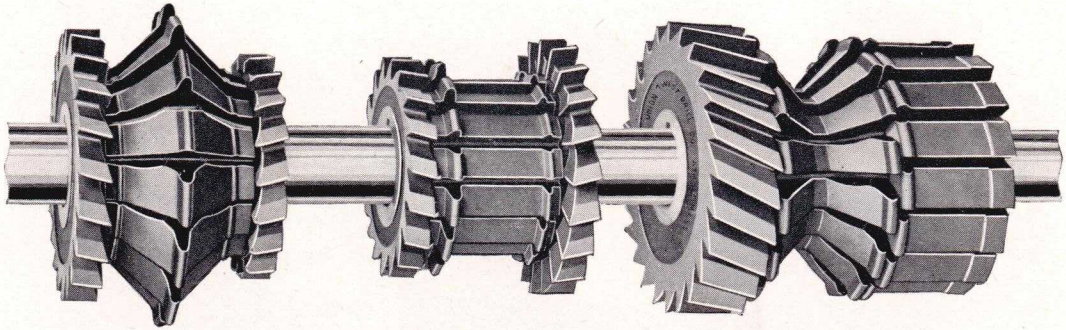


FORMED TYPE



For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

Continued on page 157



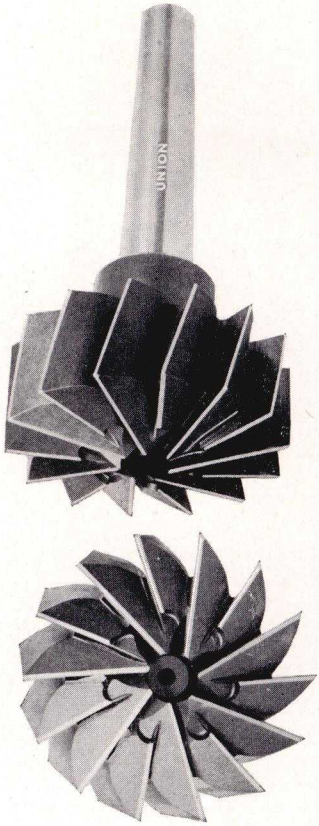
A Gang of Union Formed and Profile Cutters

CARBON AND HIGH SPEED STEEL

Many pieces which are now machined in several successive operations may be more economically handled in one operation by the use of the proper gang of formed cutters. In this case formed cutters are combined with plain mills, side mills and half side mills to finish the work in one set-up. We will be glad to suggest the proper assembly of cutters on receipt of your blue print.

Special Cutters

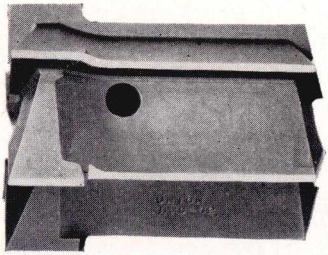
Shank Angular Mills

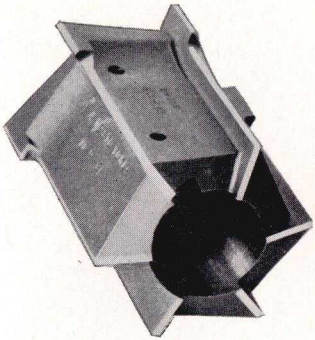


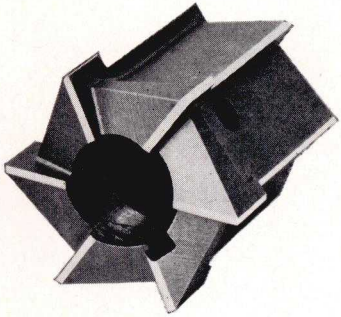
COBALT HIGH SPEED STEEL

Outside diameter $4\frac{1}{2}''$, width of cut $2\frac{1}{16}''$.
No. 10 B. & S. taper shank tapped for draw bar.
End teeth 10° angle, 14 cutting teeth.

Special Solid Gang Cutters







HIGH SPEED STEEL

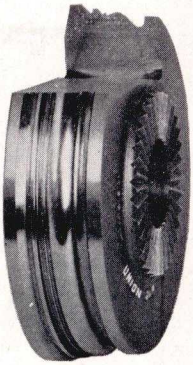
Outside diameter $2\frac{3}{16}''$, Width $2\frac{3}{4}''$, $1''$ hole, 6 cutting teeth.

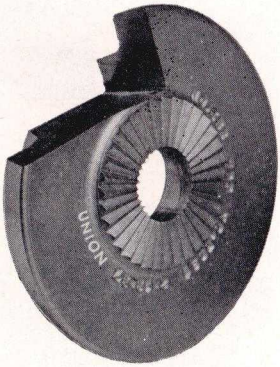
Note: Each cutter in one solid piece is a combination gang consisting of a Side Mill, Plain Milling Cutter and an Angular Cutter.

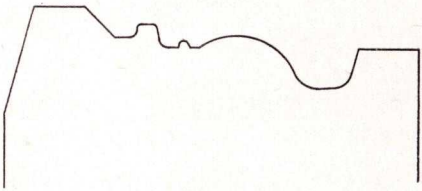
GROUND FORM TOOLS

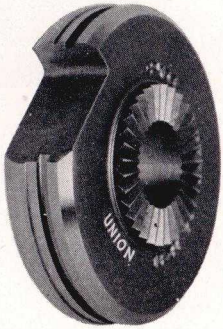
HIGH SPEED STEEL

Circular for use on Screw Machines









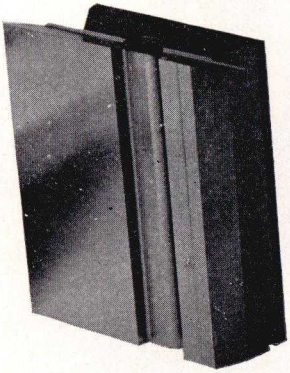
See page 161 for Straight Ground Form Tools for use on Lathes.

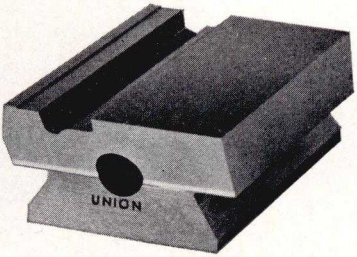
Continued on page 161

GROUND FORM TOOLS

HIGH SPEED STEEL

Straight for use on Lathes





Where extreme accuracy is required we are prepared to furnish these Ground Form Tools to particularly close limits.

When ordering or requesting prices a sample of the work to be done, or drawing showing outline required with limits of accuracy, also the type of Ground Form Tool should be furnished.

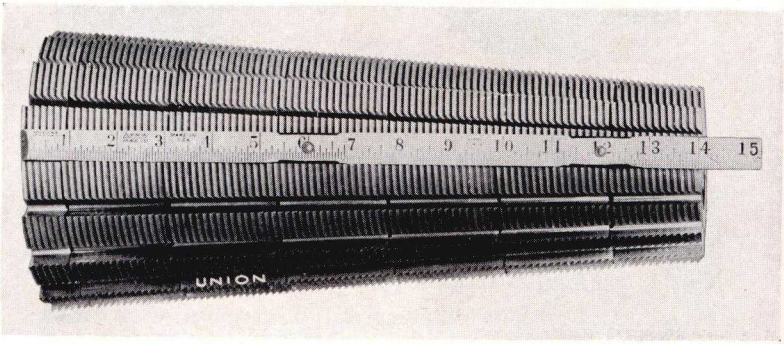
See page 160 for Circular Ground Form Tools for use on Screw Machines.

Thread Milling Cutters

ARBOR TYPE

CARBON AND HIGH SPEED STEEL

Style D



Style C

Thread Milling Cutters are made to order. Prices on application.

In ordering give Style, Pitch, Form of Thread, Length, Size Hole and Keyway.

For Machines and Fixtures used in connection with the proper sharpening of Formed Cutters see pages 288–289, 297.

For Keyway see page 8.

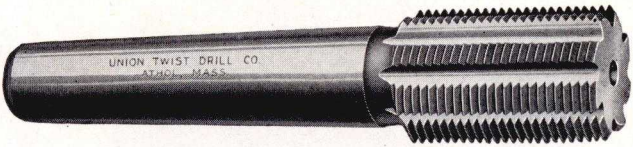
Continued on page 163

Thread Milling Cutters—continued

SHANK TYPE

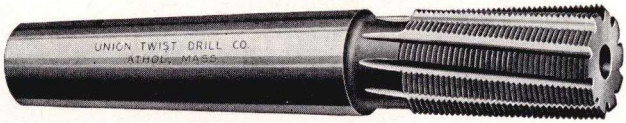
CARBON AND HIGH SPEED STEEL

Style E



Straight Cutter Straight Flutes

Style F

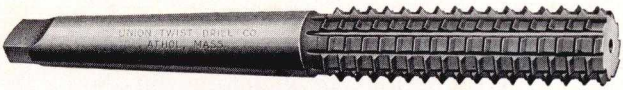


Straight Cutter Spiral Flutes

Style G

Taper Cutter Straight Flutes

Style H



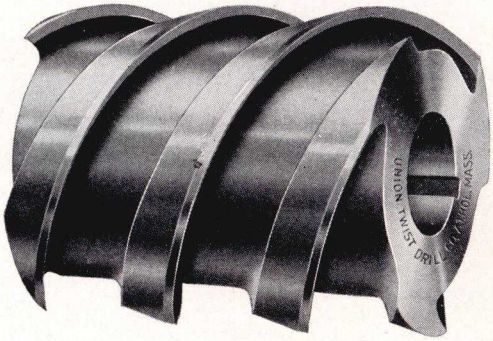
Straight Cutter Straight Flutes

ALTERNATING TEETH

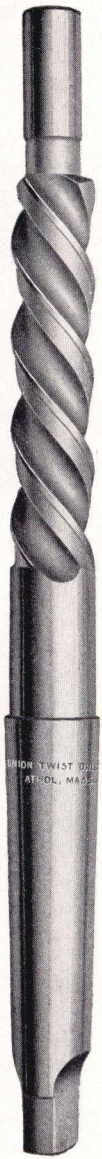
Thread Milling Cutters are made to order. Prices on application. In ordering give Diameter, Size and Style of Shank, Pitch, Form of Thread, also whether Right or Left Hand.

Helical Milling Cutters

PROFILE TYPE OF TEETH



Arbor Type



Shank Type

The name Helical Mill is used to designate a high helix angle of tooth.

The Arbor Type Mills are used for slab milling or for profiling such as cam milling and for elongating slots.

The Shank Type Mills are designed for internal milling or for elongating a slot. They are widely used in locomotive work for profiling clevis rods and piston rod key slots and similar work. It is important to maintain the sharp cutting edge of the helical teeth. This should be done with a cup wheel to insure a flat clearance.

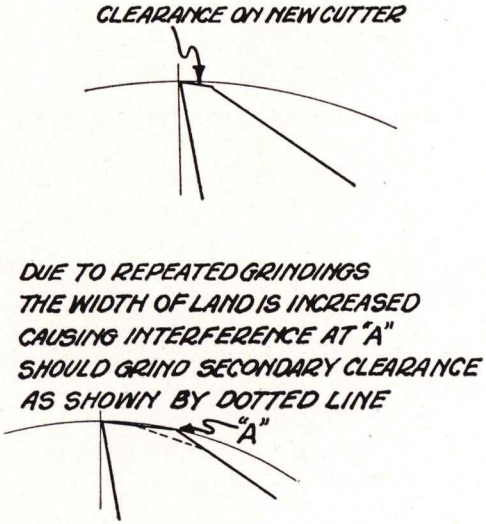
We are prepared to furnish these Shank and Arbor Type Helical Milling Cutters of Carbon or High Speed Steel. Prices on application.

Sharpening Cutters

The proper grinding of cutters is very important and great care should be exercised to insure that this operation is correctly performed. They should be sharpened frequently and regularly when in constant use. It is only by using an accurately made cutter with a keen cutting edge that the best results can be obtained, both as to quantity and quality of work.

The following drawing shows the necessity of using care in grinding Milling Cutters having coarse or heavy teeth.

Note the clearance on new cutters and the increased width of land due to repeated sharpening.



Continued on page 166

Sharpening Cutters—continued

In sharpening formed cutters a solid grinding wheel should be used, having its edge beveled on one side so as to reach the bottoms of the teeth. This wheel should be so mounted that the flat side will run true and at a velocity recommended by the manufacturers of the particular wheel used. The cutter must be so held that the face of tooth will be ground square with the sides, and it must also be radial, that is, on a line with the center, as shown in the illustrations on pages 167–168.

When this rule is departed from the shape milled by the cutter is changed from its original outline, and is often the source of trouble. This is important.

WHEELS FOR SHARPENING CUTTERS

Wheels that will grind carbon steel without drawing the temper may draw the temper on high speed steel.

High speed steel requires a softer and coarser wheel than that used for carbon steel.

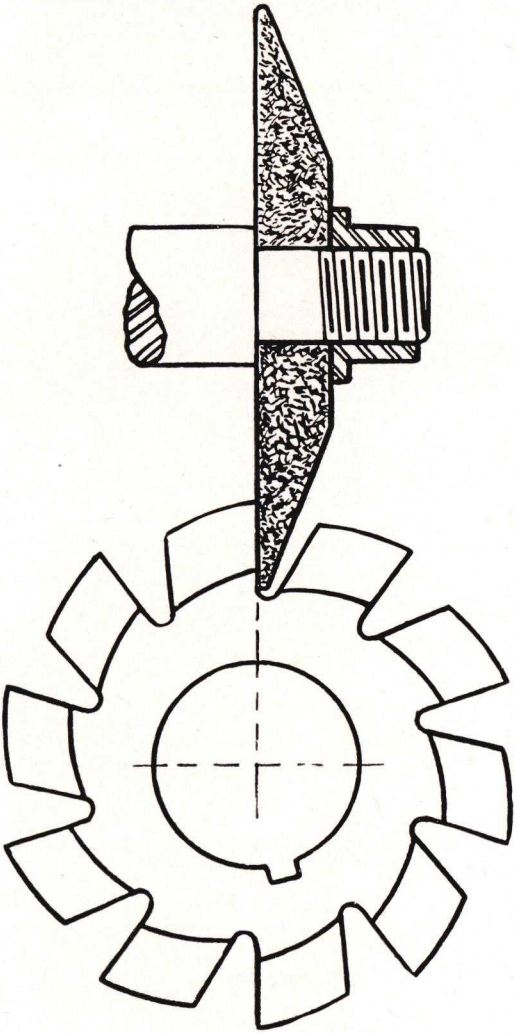
Too much care cannot be used in the selection of the proper wheel for sharpening cutters.

The various makers of grinding wheels are prepared to furnish data of interest in grinding High Speed Steel Cutters.

Continued on page 167

Sharpening Cutters—continued

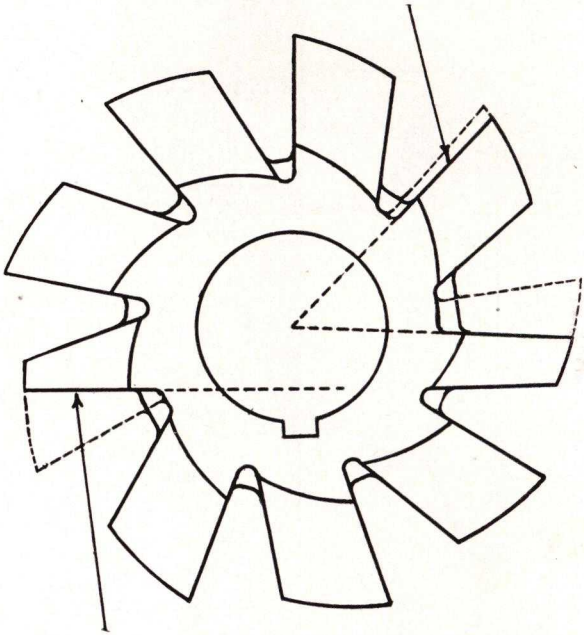
METHOD OF MOUNTING GRINDING WHEEL FOR SHARPENING FORMED CUTTERS AND PROPER POSITION WITH RELATION TO CUTTER



Continued on page 168

Sharpening Cutters—continued

TOOTH AS CORRECTLY GROUND TO SHARPEN
FACE OF TOOTH RADIAL



TOOTH AS OFTEN INCORRECTLY GROUND
FACE OF TOOTH NOT RADIAL

For Radial Grinding Gauge see page 278.

Twist Drills

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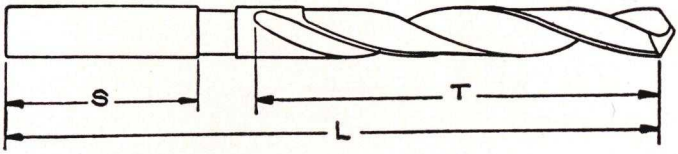
TWO AND THREE DIAMETER DRILLS

We are in a position to make special drills to suit special requirements and will be glad to quote prices on application.

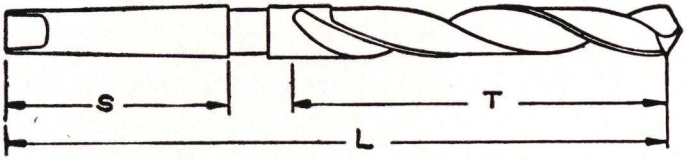
Suggestions When Ordering Special Twist Drills and Reamers

Always specify

CARBON STEEL or HIGH SPEED STEEL



When ordering Straight Shank Drills or Reamers:—always give whole length (L), length of flute (T) and length of Shank (S).



When ordering Taper Shank Drills or Reamers:—always give whole length (L), length of flute (T) and number of Taper Shank.

When a special Taper Shank is required give length of (S), diameter of one end and taper per foot. Send sample Shank Drill or Reamer if possible.

By carefully observing the above suggestions customers will often avoid delays.

Sharpening of Twist Drills

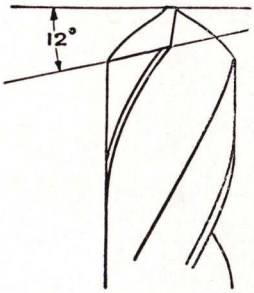


Fig. 1

The "Union" drill, as you receive it, illustrates the proper angles of clearance and point according to our experience, and for average conditions. The operator in regrinding should endeavor to maintain the same angles and to keep the point symmetrical. Great care should be used in selecting a suitable wheel for sharpening, and a generous flow of water is desirable in this operation on both Carbon and High Speed Steel drills. Hand grinding should be avoided as much as possible. The drill should pass quickly over the face of the wheel and should not be allowed to dwell at any point.

CLEARANCE ANGLE—An angle of 12° at the periphery of the drill (figure 1) is generally accepted as the best for average conditions. When this angle is right, the chisel point, or line across the end of the web, will be at an angle of 130° to either cutting edge (figure 2) and should be not less than 125°. Failure to secure proper clearance angle may cause the drill to split up the web.

It is important to make the lips of equal length; otherwise the drill will run out and the hole will be larger than the drill.

ANGLE OF POINT—The included angle of the point should be 118° as shown in figure 3, and the angle of each cutting edge with the center of the drill should be 59°. If these angles are not equal, one cutting lip does all the cutting which is indicated by a heavy chip coming out of one flute and nothing out of the other. The

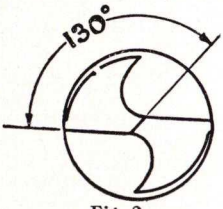


Fig. 2

Continued on page 173

Sharpening of Twist Drills—continued

drill dulls quickly and will drill an oversize hole, and may break.

THINNING THE WEB—Thinning the web is a delicate operation. This practice, or that of changing the form of the cutting edge, often causes a drill to split, for which the manufacturer should not be held responsible.

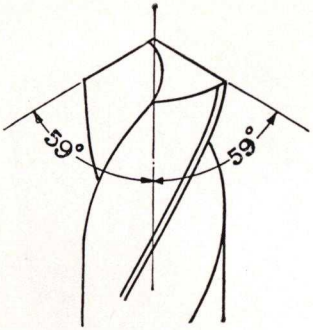


Fig. 3

BROKEN TANG—Our Taper Shank Drills are very carefully ground, and if the sleeve is in good condition, ample bearing surface is provided to drive the drill. A twisted or broken tang shows clearly that the sleeve needs attention.

SPEEDS AND FEEDS—Because of variation in material and equipment no fixed rules can be given, but the table which follows on page 175 will be helpful in indicating a satisfactory starting speed and feed. Too high a speed will lead to breaking down at the outer end of the cutting lip.

Too much feed per revolution may result in splitting the drill up the web, or chipping the cutting edge. Too little feed at a high speed burns the end of the drill.

LUBRICANTS—The following will be found helpful:
Hard Steel: Turpentine, Kerosene, Soda Water.
Soft Steel and Wrought Iron: Cutting Oil, Soda Water.
Malleable Iron: Soda Water.
Aluminum and Soft Metals: Kerosene, Soda Water.
Brass: Dry.

For Table of Feeds and Speeds see page 175.

The Improper Grinding of Drills

The above views show the condition of a 1¼″ drill that was improperly ground. This drill was point ground in one of the regular point grinders, but the flow of coolant was reduced, causing several bad cracks to appear. With the exception of the two heavier cracks, the drill looked all right, but on immersing in acid, the finer cracks immediately showed up. It will be noted that the two larger cracks extend well up the body of the drill.

This shows the importance of Grinding Drills Properly.

Table of Feeds and Speeds

HIGH SPEED STEEL DRILLS

For Carbon Steel, Use Same Feed But
Divide Speed By Two.

Size of Drill	Feed per Rev.	Cast Steel 40 Feet	Alloy Steel Drop Forging 50 Feet	Tool St. & Car. St. Drop Forgings 60 Feet	Cast Iron Hard 80 Feet	Malleable Iron 90 Feet	Mild Steel 120 Feet	Medium Cast Iron 140 Feet	Bronze Brass 300 Feet
In.	Inches	R.P.M.	R.P.M.	R.P.M.	R.P.M.	R.P.M.	R.P.M.	R.P.M.	R.P.M.
1/16	.003	2445	3056	3667	4889	5500	7328	8554	18320
3/32	.0035	1628	2038	2442	3258	3666	4884	5702	12212
1/8	.004	1222	1528	1833	2445	2750	3667	4278	9160
5/32	.0045	976	1221	1465	1954	2198	2934	3420	7328
3/16	.005	815	1019	1222	1630	1833	2445	2852	6106
7/32	.0055	698	872	1047	1396	1570	2094	2444	5234
1/4	.006	611	764	917	1222	1375	1833	2139	4575
9/32	.0065	542	678	814	1084	1222	1628	1900	4071
5/16	.007	489	611	733	978	1100	1467	1711	3660
11/32	.0075	444	555	666	888	1000	1332	1554	3330
3/8	.008	407	509	611	815	917	1222	1426	3050
13/32	.0085	376	469	563	752	846	1126	1316	2818
7/16	.009	349	437	524	698	786	1048	1222	2614
15/32	.0095	326	407	488	652	732	976	1140	2442
1/2	.010	306	382	458	611	688	917	1070	2287
9/16	.0105	271	339	407	543	611	814	950	2035
5/8	.011	244	306	367	489	550	733	856	1830
11/16	.0115	222	277	333	444	500	666	777	1665
3/4	.012	204	255	306	407	458	611	713	1525
13/16	.0125	188	234	281	376	423	562	658	1409
7/8	.013	175	218	262	349	393	524	611	1307
15/16	.0135	163	203	244	326	366	488	570	1221
1	.014	153	191	229	306	344	458	535	1143
1 1/8	.015	136	170	204	272	306	407	475	1017
1 1/4	.016	122	153	183	244	275	367	428	915
1 3/8	.016	111	139	167	222	250	333	389	833
1 1/2	.016	102	127	153	204	229	306	357	762
1 5/8	.016	94	118	141	188	212	282	329	705
1 3/4	.016	87	109	131	175	196	262	306	654
1 7/8	.016	81	102	122	163	183	244	285	610
2	.016	76	95	115	153	172	229	267	571

Taper Shank Twist Drills

HIGH SPEED STEEL

Diameter Inches	Shanks Regular No. 500			Shanks Smaller than Regular No. 502			Shanks Larger than Regular No. 505		
	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank
1/8	$1.00	5 1/8	No. 1	....	....	....	....	....	....
9/64	1.10	5 3/8		....	....	....	....	....	....
5/32	1.10	5 3/8		....	....	....	....	....	....
11/64	1.25	5 3/4		....	....	....	....	....	....
3/16	1.25	5 3/4		....	....	....	....	....	....
13/64	1.35	6		....	....	....	....	....	....
7/32	1.35	6		....	....	....	....	....	....
15/64	1.40	6 1/8		....	....	....	....	....	....
1/4	1.40	6 1/8		....	....	....	....	....	....
17/64	1.50	6 1/4		....	....	....	....	....	....
9/32	1.50	6 1/4		....	....	....	....	....	....
19/64	1.60	6 3/8		....	....	....	....	....	....
5/16	1.60	6 3/8		....	....	....	....	....	....
21/64	1.70	6 1/2		....	....	....	....	....	....
11/32	1.70	6 1/2		....	....	....	....	....	....
23/64	1.90	6 3/4		....	....	....	....	....	....
3/8	1.90	6 3/4		....	....	....	$2.10	7 3/8	No. 2
25/64	2.10	7		....	....	....	2.25	7 1/2	
13/32	2.10	7		....	....	....	2.25	7 1/2	
27/64	2.30	7 1/4		....	....	....	2.45	7 3/4	
7/16	2.30	7 1/4		....	....	....	2.45	7 3/4	
29/64	2.50	7 1/2		....	....	....	2.65	8	
15/32	2.50	7 1/2		....	....	....	2.65	8	
31/64	2.95	8 1/4	No. 2	$2.75	7 3/4	No. 1	....	....	....
1/2	2.95	8 1/4		2.75	7 3/4		....	....	....
33/64	3.25	8 1/2		3.05	8		....	....	....
17/32	3.25	8 1/2		3.05	8		....	....	....
35/64	3.75	8 3/4		3.50	8 1/4		....	....	....
9/16	3.75	8 3/4		3.50	8 1/4		....	....	....

Shanks Regular—No. 500 will be supplied unless otherwise specified.

For Sockets and Sleeves see pages 274–275.

List continued on page 177

Taper Shank Twist Drills—continued

HIGH SPEED STEEL

Diameter Inches	Shanks Regular No. 500			Shanks Smaller than Regular No. 502			Shanks Larger than Regular No. 505		
	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank
37/64	$4.00	8¾	No. 2	....	....	....	....	....	....
19/32	4.00	8¾		....	....	....	....	....	....
39/64	4.25	8¾		....	....	....	....	....	....
5/8	4.25	8¾		....	....	....	....	....	....
41/64	4.75	9		....	....	....	$5.15	9¾	No. 3
21/32	4.75	9		....	....	....	5.15	9¾	
43/64	5.25	9¼		....	....	....	5.70	10	
11/16	5.25	9¼		....	....	....	5.70	10	
45/64	5.75	9½		....	....	....	6.20	10¼	
23/32	5.75	9½		....	....	....	6.20	10¼	
47/64	6.25	9¾		....	....	....	6.75	10½	
3/4	6.25	9¾		....	....	....	6.75	10½	
49/64	6.50	9⅞		....	....	....	7.00	10⅝	
25/32	6.50	9⅞		....	....	....	7.00	10⅝	
51/64	7.25	10¾	No. 3	$6.75	10	No. 2	....	....	....
13/16	7.25	10¾		6.75	10		....	....	....
53/64	7.65	10¾		7.15	10		....	....	....
27/32	7.65	10¾		7.15	10		....	....	....
55/64	8.05	10¾		7.50	10		....	....	....
7/8	8.05	10¾		7.50	10		....	....	....
57/64	8.45	10¾		7.85	10		....	....	....
29/32	8.45	10¾		7.85	10		....	....	....
59/64	8.85	10¾		....	....	....	....	....	....
15/16	8.85	10¾		....	....	....	....	....	....
61/64	9.65	11		....	....	....	....	....	....
31/32	9.65	11		....	....	....	....	....	....
63/64	10.25	11		....	....	....	....	....	....
1″	10.25	11		....	....	....	$11.20	12	No. 4
1 1/64	11.00	11⅛		....	....	....	12.00	12⅛	

Shanks Regular—No. 500 will be supplied unless otherwise specified.

For Sockets and Sleeves see pages 274–275.

List continued on page 178

Taper Shank Twist Drills—continued

HIGH SPEED STEEL

Diameter Inches	Shanks Regular No. 500			Shanks Smaller than Regular No. 502			Shanks Larger than Regular No. 505		
	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank
1 1/32	$11.00	11 1/8	No. 3	....	....	....	$12.00	12 1/8	No. 4
1 3/64	11.75	11 1/4		....	....	....	12.80	12 1/4	
1 1/16	11.75	11 1/4		....	....	....	12.80	12 1/4	
1 5/64	13.25	12 1/2		$12.20	11 1/2	No. 3	....	....	....
1 3/32	13.25	12 1/2		12.20	11 1/2		....	....	....
1 7/64	14.25	12 3/4		13.15	11 3/4		....	....	....
1 1/8	14.25	12 3/4		13.15	11 3/4		....	....	....
1 9/64	15.00	12 7/8		13.85	11 7/8		....	....	....
1 5/32	15.00	12 7/8		13.85	11 7/8		....	....	....
1 11/64	15.75	13		14.55	12		....	....	....
1 3/16	15.75	13		14.55	12		....	....	....
1 13/64	16.50	13 1/8		15.25	12 1/8		....	....	....
1 7/32	16.50	13 1/8		15.25	12 1/8		....	....	....
1 15/64	18.00	13 1/2		16.65	12 1/2		....	....	....
1 1/4	18.00	13 1/2		16.65	12 1/2		....	....	....
1 17/64	20.00	14 1/8	No. 4	....	....	....	....	....	....
1 9/32	20.00	14 1/8		....	....	....	....	....	....
1 19/64	20.75	14 1/4		....	....	....	....	....	....
1 5/16	20.75	14 1/4		....	....	....	....	....	....
1 21/64	21.50	14 3/8		....	....	....	....	....	....
1 11/32	21.50	14 3/8		....	....	....	....	....	....
1 23/64	22.25	14 1/2		....	....	....	....	....	....
1 3/8	22.25	14 1/2		....	....	....	....	....	....
1 25/64	23.00	14 5/8		....	....	....	....	....	....
1 13/32	23.00	14 5/8		....	....	....	....	....	....
1 27/64	23.75	14 3/4		....	....	....	....	....	....
1 7/16	23.75	14 3/4		....	....	....	....	....	....
1 29/64	24.50	14 7/8		....	....	....	....	....	....
1 15/32	24.50	14 7/8		....	....	....	....	....	....

Shanks Regular—No. 500 will be supplied unless otherwise specified.
For Sockets and Sleeves see pages 274–275.

List continued on page 179

Taper Shank Twist Drills—continued

HIGH SPEED STEEL

Diameter Inches	Shanks Regular No. 500			Shanks Smaller than Regular No. 502			Shanks Larger than Regular No. 505		
	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank
1 31/64	$25.25	15	No. 4	....	....	....	....	....	....
1 1/2	25.25	15		....	....	....	....	....	....
1 33/64	28.75	16 3/8	No. 5	$26.35	15	No. 4	....	....	....
1 17/32	28.75	16 3/8		26.35	15		....	....	....
1 35/64	30.75	16 5/8		28.20	15 1/4		....	....	....
1 9/16	30.75	16 5/8		28.20	15 1/4		....	....	....
1 37/64	32.75	16 7/8		30.10	15 1/2		....	....	....
1 19/32	32.75	16 7/8		30.10	15 1/2		....	....	....
1 39/64	34.00	17		31.25	15 5/8		....	....	....
1 5/8	34.00	17		31.25	15 5/8		....	....	....
1 41/64	35.25	17 1/8		32.40	15 3/4		....	....	....
1 21/32	35.25	17 1/8		32.40	15 3/4		....	....	....
1 43/64	36.50	17 1/8		33.55	15 3/4		....	....	....
1 11/16	36.50	17 1/8		33.55	15 3/4		....	....	....
1 45/64	37.75	17 1/8		34.70	15 3/4		....	....	....
1 23/32	37.75	17 1/8		34.70	15 3/4		....	....	....
1 47/64	39.00	17 1/8		37.00	16 1/4		....	....	....
1 3/4	39.00	17 1/8		37.00	16 1/4		....	....	....
1 25/32	40.25	17 1/8		38.20	16 1/4		....	....	....
1 13/16	41.50	17 1/8		39.40	16 1/4		....	....	....
1 27/32	42.75	17 1/8		40.55	16 1/4		....	....	....
1 7/8	45.00	17 3/8		42.75	16 1/2		....	....	....
1 29/32	46.25	17 3/8		43.95	16 1/2		....	....	....
1 15/16	47.50	17 3/8		45.45	16 5/8		....	....	....
1 31/32	48.75	17 3/8		46.65	16 5/8		....	....	....
2″	50.00	17 3/8		47.85	16 5/8		....	....	....
2 1/32	51.75	17 3/8		....	....	....	....	....	....
2 1/16	53.50	17 3/8		....	....	....	....	....	....
2 3/32	55.25	17 3/8		....	....	....	....	....	....

Shanks Regular—No. 500 will be supplied unless otherwise specified.
For Sockets and Sleeves see pages 274–275.

List continued on page 180

Taper Shank Twist Drills—continued

HIGH SPEED STEEL

Diameter Inches	Shanks Regular No. 500			Shanks Smaller than Regular No. 502			Shanks Larger than Regular No. 505		
	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank	Price Each	Whole Length Inches	Morse Taper Shank
2 1/8	$57.00	17 3/8		....	....	....	....	....	....
2 5/32	58.75	17 3/8		....	....	....	....	....	....
2 3/16	60.50	17 3/8		....	....	....	....	....	....
2 7/32	62.25	17 3/8		....	....	....	....	....	....
2 1/4	64.00	17 3/8		....	....	....	....	....	....
2 5/16	67.50	17 3/8		....	....	....	....	....	....
2 3/8	71.00	17 3/8		....	....	....	....	....	....
2 7/16	87.50	18 3/4		....	....	....	....	....	....
2 1/2	91.00	18 3/4	No. 5	....	....	....	....	....	....
2 9/16	100.00	19 1/2		....	....	....	....	....	....
2 5/8	105.00	19 1/2		....	....	....	....	....	....
2 11/16	115.50	20 3/8		....	....	....	....	....	....
2 3/4	120.50	20 3/8		....	....	....	....	....	....
2 13/16	129.50	21 1/8		....	....	....	....	....	....
2 7/8	135.00	21 1/8		....	....	....	....	....	....
2 15/16	142.50	21 3/4		....	....	....	....	....	....
3″	150.00	21 3/4		....	....	....	....	....	....
3 1/16	178.00	24 7/16		$160.00	22		....	....	....
3 1/8	189.00	24 7/16		170.00	22		....	....	....
3 3/16	200.00	24 7/16		180.00	22		....	....	....
3 1/4	216.00	25 7/16	No. 6	195.00	23	No. 5	....	....	....
3 5/16	232.00	25 7/16		210.00	23		....	....	....
3 3/8	249.00	25 7/16		225.00	23		....	....	....
3 7/16	266.00	25 7/16		240.00	23		....	....	....
3 1/2	287.00	26 7/16		260.00	24		....	....	....

Shanks Regular—No. 500 will be supplied unless otherwise specified.

For Sockets and Sleeves see pages 274–275.

Taper Shank Twist Drills

CARBON STEEL No. 100

Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank	Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank
1/8	$0.45	5 1/8	No. 1	17/32	$1.30	8	No. 1
9/64	.45	5 3/8		35/64	1.40	8 1/4	
5/32	.45	5 3/8		9/16	1.40	8 1/4	
11/64	.50	5 3/4					
3/16	.50	5 3/4		37/64	1.50	8 3/4	No. 2
13/64	.55	6		19/32	1.50	8 3/4	
7/32	.55	6		39/64	1.60	8 3/4	
15/64	.60	6 1/8		5/8	1.60	8 3/4	
1/4	.60	6 1/8		41/64	1.70	9	
17/64	.65	6 1/4		21/32	1.70	9	
9/32	.65	6 1/4		43/64	1.80	9 1/4	
19/64	.70	6 3/8		11/16	1.80	9 1/4	
5/16	.70	6 3/8		45/64	1.90	9 1/2	
21/64	.75	6 1/2		23/32	1.90	9 1/2	
11/32	.75	6 1/2		47/64	2.00	9 3/4	
23/64	.80	6 3/4		3/4	2.00	9 3/4	
3/8	.80	6 3/4		49/64	2.10	9 7/8	
25/64	.90	7		25/32	2.10	9 7/8	
13/32	.90	7		51/64	2.20	10	
27/64	1.00	7 1/4		13/16	2.20	10	
7/16	1.00	7 1/4		53/64	2.40	10	
29/64	1.10	7 1/2		27/32	2.40	10	
15/32	1.10	7 1/2		55/64	2.60	10	
31/64	1.20	7 3/4		7/8	2.60	10	
1/2	1.20	7 3/4		57/64	2.80	10	
33/64	1.30	8		29/32	2.80	10	

For sets of Taper Shank Drills see page 210.

For Sockets and Sleeves see pages 274–275.

List continued on page 182

Taper Shank Twist Drills—continued

CARBON STEEL No. 100

Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank
59/64	$3.00	10 3/4	No. 3
15/16	3.00	10 3/4	
61/64	3.25	11	
31/32	3.25	11	
63/64	3.50	11	
1″	3.50	11	
1 1/64	3.75	11 1/8	
1 1/32	3.75	11 1/8	
1 3/64	4.00	11 1/4	
1 1/16	4.00	11 1/4	
1 5/64	4.25	11 1/2	
1 3/32	4.25	11 1/2	
1 7/64	4.50	11 3/4	
1 1/8	4.50	11 3/4	
1 9/64	4.75	11 7/8	
1 5/32	4.75	11 7/8	
1 11/64	5.00	12	
1 3/16	5.00	12	
1 13/64	5.25	12 1/8	
1 7/32	5.25	12 1/8	
1 15/64	5.50	12 1/2	
1 1/4	5.50	12 1/2	
1 9/32	5.75	14 1/8	No. 4
1 5/16	6.00	14 1/4	
1 11/32	6.25	14 3/8	
1 3/8	6.50	14 1/2	
1 13/32	7.00	14 5/8	
1 7/16	7.50	14 3/4	
1 15/32	8.00	14 7/8	
1 1/2	8.50	15	
1 17/32	9.00	15	

Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank
1 9/16	$ 9.50	15 1/4	No. 4
1 19/32	10.00	15 1/2	
1 5/8	10.50	15 5/8	
1 21/32	11.00	15 3/4	
1 11/16	11.50	15 3/4	
1 23/32	12.00	15 3/4	
1 3/4	12.50	16 1/4	
1 25/32	13.25	16 1/4	
1 13/16	14.00	16 1/4	
1 27/32	14.75	16 1/4	
1 7/8	15.50	16 1/2	
1 29/32	16.25	16 1/2	
1 15/16	17.00	16 5/8	
1 31/32	17.75	16 5/8	
2″	18.50	16 5/8	
2 1/16	20.00	17 3/8	No. 5
2 1/8	21.50	17 3/8	
2 3/16	23.00	17 3/8	
2 1/4	24.50	17 3/8	
2 5/16	26.00	17 3/8	
2 3/8	27.50	17 3/8	
2 7/16	29.00	18 3/4	
2 1/2	30.50	18 3/4	
2 9/16	32.00	19 1/2	
2 5/8	34.00	19 1/2	
2 11/16	36.00	20 3/8	
2 3/4	38.00	20 3/8	
2 13/16	40.50	21 1/8	
2 7/8	43.00	21 1/8	
2 15/16	45.50	21 3/4	
3″	48.00	21 3/4	

For sets of Taper Shank Drills see page 210.
For Sockets and Sleeves see pages 274–275.

Combined Drills and Countersinks

CARBON STEEL No. 245 **HIGH SPEED STEEL No. 645**

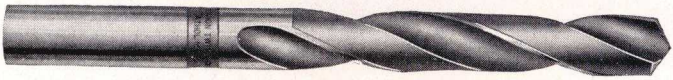
Included angle 60 degrees. Other angles made to order at special prices.

Catalog No.	Diameter Drill Inches	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Whole Length Inches	Diameter Body Inches
*A-1	3/64	$2.50	$ 8.00	1 1/4	1/8
*C-2	1/16	3.00	8.00	1 7/8	13/64
*D-1	5/64	3.25	8.00	2	15/64
*E-1	3/32	3.50	8.00	2 1/8	3/10
*E-2	1/8	3.50	8.00	2 1/8	3/10
*F-1	5/32	4.50	12.00	2 3/4	7/16
*F-2	3/16	4.50	12.00	2 3/4	7/16
J-1	7/32	5.75	18.00	3	1/2
J-2	9/32	5.75	18.00	3	1/2
M-1	7/32	9.00	24.00	3 1/4	5/8
M-2	9/32	9.00	24.00	3 1/4	5/8
N-1	1/4	....	32.00	3 1/2	3/4
N-2	5/16	....	32.00	3 1/2	3/4

* Contained in combined Drill and Countersink Set No. 21 see page 215.

Straight Shank Twist Drills

TAPER LENGTH



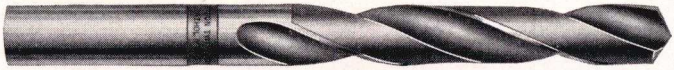
CARBON STEEL No. 110 **HIGH SPEED STEEL No. 510**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches
1/8	$0.45	$1.00	5 1/8	15/32	$1.10	$2.50	7 1/2
9/64	.45	1.10	5 3/8	31/64	1.20	2.75	7 3/4
5/32	.45	1.10	5 3/8	1/2	1.20	2.75	7 3/4
11/64	.50	1.25	5 3/4	33/64	1.30	3.05	8
3/16	.50	1.25	5 3/4	17/32	1.30	3.05	8
13/64	.55	1.35	6	35/64	1.40	3.50	8 1/4
7/32	.55	1.35	6	9/16	1.40	3.50	8 1/4
15/64	.60	1.40	6 1/8	37/64	1.50	4.00	8 3/4
1/4	.60	1.40	6 1/8	19/32	1.50	4.00	8 3/4
17/64	.65	1.50	6 1/4	39/64	1.60	4.25	8 3/4
9/32	.65	1.50	6 1/4	5/8	1.60	4.25	8 3/4
19/64	.70	1.60	6 3/8	41/64	1.70	4.75	9
5/16	.70	1.60	6 3/8	21/32	1.70	4.75	9
21/64	.75	1.70	6 1/2	43/64	1.80	5.25	9 1/4
11/32	.75	1.70	6 1/2	11/16	1.80	5.25	9 1/4
23/64	.80	1.90	6 3/4	45/64	1.90	5.75	9 1/2
3/8	.80	1.90	6 3/4	23/32	1.90	5.75	9 1/2
25/64	.90	2.10	7	47/64	2.00	6.25	9 3/4
13/32	.90	2.10	7	3/4	2.00	6.25	9 3/4
27/64	1.00	2.30	7 1/4	49/64	2.10	6.50	9 7/8
7/16	1.00	2.30	7 1/4	25/32	2.10	6.50	9 7/8
29/64	1.10	2.50	7 1/2	51/64	2.20	6.75	10

List continued on page 185

Straight Shank Twist Drills—continued

TAPER LENGTH



CARBON STEEL No. 110 **HIGH SPEED STEEL No. 510**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches
13/16	$2.20	$ 6.75	10	1 3/16	$5.00	$14.55	12
53/64	2.40	7.15	10	1 13/64	5.25	15.25	12 1/8
27/32	2.40	7.15	10	1 7/32	5.25	15.25	12 1/8
55/64	2.60	7.50	10	1 15/64	5.50	16.65	12 1/2
7/8	2.60	7.50	10	1 1/4	5.50	16.65	12 1/2
57/64	2.80	7.85	10	1 9/32	5.75	20.00	14 1/8
29/32	2.80	7.85	10	1 5/16	6.00	20.75	14 1/4
59/64	3.00	8.85	10 3/4	1 11/32	6.25	21.50	14 3/8
15/16	3.00	8.85	10 3/4	1 3/8	6.50	22.25	14 1/2
61/64	3.25	9.65	11	1 13/32	7.00	23.00	14 5/8
31/32	3.25	9.65	11	1 7/16	7.50	23.75	14 3/4
63/64	3.50	10.25	11	1 15/32	8.00	24.50	14 7/8
1″	3.50	10.25	11	1 1/2	8.50	25.25	15
1 1/64	3.75	11.00	11 1/8	1 9/16		28.20	15 1/4
1 1/32	3.75	11.00	11 1/8	1 5/8		31.25	15 5/8
1 3/64	4.00	11.75	11 1/4	1 11/16		33.55	15 3/4
1 1/16	4.00	11.75	11 1/4	1 3/4		37.00	16 1/4
1 5/64	4.25	12.20	11 1/2	1 13/16		39.40	16 1/4
1 3/32	4.25	12.20	11 1/2	1 7/8		42.75	16 1/2
1 7/64	4.50	13.15	11 3/4	1 15/16		45.45	16 5/8
1 1/8	4.50	13.15	11 3/4	2″		47.85	16 5/8
1 9/64	4.75	13.85	11 7/8				
1 5/32	4.75	13.85	11 7/8				
1 11/64	5.00	14.55	12				

Center Drills

FRACTIONAL SIZES

CARBON STEEL No. 235

Diameter Inches	Price per Dozen	Whole Length Inches	Length of Flute Inches
1/32	$1.50	1 1/8	5/8
3/64	1.55	1 1/8	5/8
1/16	1.60	1 1/4	3/4
5/64	1.65	1 1/4	3/4
3/32	1.70	1 1/4	3/4
7/64	1.75	1 1/4	3/4
1/8	1.80	1 1/4	3/4
9/64	1.85	1 1/4	3/4
5/32	1.90	1 1/2	1
11/64	2.00	1 1/2	1
3/16	2.25	1 1/2	1
13/64	2.50	1 1/2	1
7/32	2.75	1 1/2	1
15/64	3.00	1 1/2	1
1/4	3.25	1 1/2	1
17/64	3.50	1 1/2	1
9/32	3.80	1 1/2	1
19/64	4.00	1 1/2	1
5/16	4.35	1 1/2	1

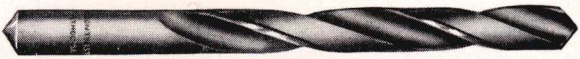
WIRE GAUGE SIZES

CARBON STEEL No. 240

Wire Gauge No.	Price per Dozen	Decimal Equivalent	Whole Length Inches	Length of Flute Inches
30	$1.80	.1285	1 1/4	3/4
35	1.75	.110	1 1/4	3/4
40	1.75	.0980	1 1/4	3/4
45	1.70	.082	1 1/4	3/4
50	1.65	.070	1 1/4	3/4
55	1.60	.052	1 1/4	3/4

Straight Shank Twist Drills

JOBBERS' LENGTH



CARBON STEEL No. 115 **HIGH SPEED STEEL No. 515**

Diameter Inches	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Whole Length Inches
1/64	$ 1.50	$ 4.25	7/8
1/32	1.50	3.50	1 1/2
3/64	1.55	2.40	1 3/4
1/16	1.60	3.00	2 1/2
5/64	1.65	3.10	2 5/8
3/32	1.70	3.20	2 3/4
7/64	1.75	3.40	2 7/8
1/8	1.80	3.60	3
9/64	1.85	3.90	3 1/8
5/32	1.90	4.20	3 1/4
11/64	2.00	4.50	3 3/8
3/16	2.25	4.85	3 1/2
13/64	2.50	5.25	3 5/8
7/32	2.75	5.75	3 3/4
15/64	3.00	6.25	3 7/8
1/4	3.25	6.75	4
17/64	3.50	7.50	4 1/8
9/32	3.80	8.25	4 1/4
19/64	4.00	9.00	4 3/8
5/16	4.35	9.75	4 1/2
21/64	4.70	10.75	4 5/8
11/32	5.05	11.75	4 3/4
23/64	5.50	12.75	4 7/8
3/8	6.00	13.75	5
25/64	6.50	15.00	5 1/8
13/32	7.00	16.25	5 1/4
27/64	7.75	17.50	5 3/8
7/16	8.50	18.75	5 1/2
29/64	9.25	20.00	5 5/8
15/32	10.00	21.25	5 3/4
31/64	11.00	22.75	5 7/8
1/2	12.00	24.25	6

Also furnished left hand. See page 206.

Carbon Drills for use in brass are carried in stock and take above list prices of No. 115.

When ordering specify No. 321 "for brass." See page 208.

For sets of Jobbers' Length Drills see pages 211, 213, 216.

Straight Shank Twist Drills

WIRE GAUGE SIZES

CARBON STEEL No. 125		HIGH SPEED STEEL No. 525		
Wire Gauge No.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length Inches
1	$2.75	$6.45	.2280	4
2	2.75	6.45	.2210	3 15/16
3	2.75	6.15	.2130	3 15/16
4	2.75	5.95	.2090	3 7/8
5	2.75	5.95	.2055	3 13/16
6	2.50	5.95	.2040	3 13/16
7	2.50	5.45	.2010	3 3/4
8	2.50	5.45	.1990	3 11/16
9	2.50	5.45	.1960	3 11/16
10	2.50	5.25	.1935	3 5/8
11	2.25	5.25	.1910	3 9/16
12	2.25	5.25	.1890	3 9/16
13	2.25	4.85	.1850	3 1/2
14	2.25	4.85	.1820	3 7/16
15	2.25	4.85	.1800	3 7/16
16	2.00	4.65	.1770	3 3/8
17	2.00	4.65	.1730	3 5/16
18	2.00	4.50	.1695	3 5/16
19	2.00	4.35	.1660	3 1/4
20	2.00	4.35	.1610	3 3/16
21	1.90	4.35	.1590	3 3/16
22	1.90	4.15	.1570	3 1/8
23	1.90	4.05	.1540	3 1/16
24	1.90	4.05	.1520	3 1/16
25	1.90	3.90	.1495	3
26	1.80	3.90	.1470	2 15/16
27	1.80	3.90	.1440	2 15/16
28	1.80	3.60	.1405	2 7/8
29	1.80	3.60	.1360	2 13/16
30	1.80	3.60	.1285	2 13/16
31	1.75	3.30	.1200	2 3/4
32	1.75	3.30	.1160	2 11/16
33	1.75	3.30	.1130	2 11/16
34	1.75	3.15	.1110	2 5/8
35	1.75	3.15	.1100	2 9/16
36	1.75	3.10	.1065	2 9/16
37	1.75	2.95	.1040	2 1/2
38	1.75	2.95	.1015	2 7/16
39	1.75	2.95	.0995	2 7/16
40	1.75	2.80	.0980	2 3/8

Also furnished left hand. See page 206.
Carbon Drills for use in brass are carried in stock and take above list prices of No. 125.
When ordering specify No. 324 "for brass." See page 208.
For sets of Wire Gauge Drills see pages 210–213, 216.

List continued on page 189

Straight Shank Twist Drills—continued

WIRE GAUGE SIZES

CARBON STEEL No. 125 **HIGH SPEED STEEL No. 525**

Wire Gauge No.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length Inches
41	$1.70	$2.80	.0960	2 5/16
42	1.70	2.75	.0935	2 5/16
43	1.70	2.60	.0890	2 1/4
44	1.70	2.60	.0860	2 3/16
45	1.70	2.60	.0820	2 3/16
46	1.65	2.50	.0810	2 1/8
47	1.65	2.50	.0785	2 1/16
48	1.65	2.50	.0760	2 1/16
49	1.65	2.50	.0730	2
50	1.65	2.40	.0700	1 15/16
51	1.60	2.40	.0670	1 15/16
52	1.60	2.40	.0635	1 7/8
53	1.60	2.40	.0595	1 13/16
54	1.60	2.40	.0550	1 13/16
55	1.60	2.40	.0520	1 3/4
56	1.55	2.40	.0465	1 11/16
57	1.55	2.40	.0430	1 11/16
58	1.55	2.40	.0420	1 5/8
59	1.55	2.40	.0410	1 9/16
60	1.55	2.40	.0400	1 9/16
61	1.50	3.50	.0390	1 1/2
62	1.50	3.50	.0380	1 1/2
63	1.50	3.50	.0370	1 1/2
64	1.50	3.50	.0360	1 1/2
65	1.50	3.50	.0350	1 1/2
66	1.50	3.50	.0330	1 1/2
67	1.50	3.50	.0320	1 7/16
68	1.50	3.50	.0310	1 7/16
69	1.50	3.50	.0292	1 3/8
70	1.50	3.50	.0280	1 5/16
71	1.50	4.25	.0260	1 5/16
72	1.50	4.25	.0250	1 1/4
73	1.50	4.25	.0240	1 3/16
74	1.50	4.25	.0225	1 1/8
75	1.50	4.25	.0210	1 1/16
76	1.50	4.25	.0200	1
77	1.50	4.25	.0180	15/16
78	1.50	4.25	.0160	7/8
79	1.50	4.25	.0145	13/16
80	1.50	4.25	.0135	3/4

Also furnished left hand. See page 206.
Carbon Drills for use in brass are carried in stock and take above list prices of No. 125 When ordering specify No. 324 "for brass." See page 208.
For sets of Wire Gauge Drills see pages 210—213, 216.

Taper Shank Twist Drills

LETTER SIZES

HIGH SPEED STEEL No. 521

Letter Size	Price Each	Decimal Equivalent	Whole Length Inches	Morse Taper Shank
A	$1.40	.234	6 1/8	No. 1
B	1.40	.238	6 1/8	
C	1.40	.242	6 1/8	
D	1.40	.246	6 1/8	
E	1.40	.250	6 1/8	
F	1.50	.257	6 1/4	
G	1.50	.261	6 1/4	
H	1.50	.266	6 1/4	
I	1.50	.272	6 1/4	
J	1.50	.277	6 1/4	
K	1.50	.281	6 1/4	
L	1.60	.290	6 3/8	
M	1.60	.295	6 3/8	
N	1.60	.302	6 3/8	
O	1.70	.316	6 1/2	
P	1.70	.323	6 1/2	
Q	1.70	.332	6 1/2	
R	1.70	.339	6 1/2	
S	1.90	.348	6 3/4	
T	1.90	.358	6 3/4	
U	1.90	.368	6 3/4	
V	2.10	.377	7	
W	2.10	.386	7	
X	2.10	.397	7	
Y	2.10	.404	7	
Z	2.30	.413	7 1/4	
U	2.10	.368	7 3/8	No. 2
V	2.25	.377	7 1/2	
W	2.25	.386	7 1/2	
X	2.25	.397	7 1/2	
Y	2.25	.404	7 1/2	
Z	2.45	.413	7 3/4	

For Straight Shank Twist Drills—Letter Sizes see page 191.
For Sockets and Sleeves see pages 274–275.

Straight Shank Twist Drills

LETTER SIZES

CARBON STEEL NO. 120 **HIGH SPEED STEEL No. 520**

Letter Size	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length Inches
A	$3.00	$ 6.25	.234	3 7/8
B	3.05	6.55	.238	3 7/8
C	3.10	6.55	.242	3 7/8
D	3.15	6.75	.246	4
E	3.25	6.75	.250	4
F	3.35	7.50	.257	4 1/8
G	3.45	7.50	.261	4 1/8
H	3.50	8.00	.266	4 1/8
I	3.65	8.00	.272	4 1/8
J	3.70	8.00	.277	4 1/8
K	3.80	8.25	.281	4 1/4
L	3.90	8.75	.290	4 1/4
M	4.00	9.00	.295	4 3/8
N	4.25	9.50	.302	4 3/8
O	4.40	10.45	.316	4 1/2
P	4.60	10.75	.323	4 5/8
Q	4.75	11.75	.332	4 3/4
R	5.05	11.75	.339	4 3/4
S	5.15	12.75	.348	4 7/8
T	5.50	12.75	.358	4 7/8
U	6.00	13.75	.368	5
V	6.00	14.65	.377	5
W	6.50	15.00	.386	5 1/8
X	6.75	15.85	.397	5 1/8
Y	7.00	15.85	.404	5 1/4
Z	7.25	17.10	.413	5 1/4

For set of Letter Size Drills see page 212.

For Taper Shank Twist Drills—Letter Sizes see page 190.

Carbon and High Speed Steel Left Hand Letter Size Drills are carried in stock. List prices same as above.

Prentice Drills

TAPER LENGTH OR LONG SET

Style No. 2

Shank ½ inch diameter, 2½ inches long

CARBON STEEL No. 150

Diameter Inches	Price Each	Whole Length Inches	Diameter Inches	Price Each	Whole Length Inches
3/8	$0.80	6¾	23/32	$1.90	9½
13/32	.90	7	3/4	2.00	9¾
7/16	1.00	7¼	25/32	2.10	9⅞
15/32	1.10	7½	13/16	2.20	10
1/2	1.20	7¾	27/32	2.40	10¼
17/32	1.30	8	7/8	2.60	10½
9/16	1.40	8¼	29/32	2.80	10⅝
19/32	1.50	8½	15/16	3.00	10¾
5/8	1.60	8¾	31/32	3.25	10⅞
21/32	1.70	9	1″	3.50	11
11/16	1.80	9¼			

Prentice Drills Taper Length No. 150 are regularly furnished with flatted shank.

Prentice Drills

SIX INCH OR SHORT SET

Style No. 2

Shank ½ inch diameter, 2½ inches long

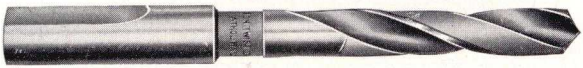
CARBON STEEL No. 155 **HIGH SPEED STEEL No. 555**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches
1/8	$ .45	$1.40	4 7/8	23/32	$1.60	$5.25	6
5/32	.45	1.50	5 1/8	3/4	1.70	5.50	6
3/16	.50	1.60	5 1/2	25/32	1.80	5.75	6
7/32	.55	1.75	5 3/4	13/16	1.90	6.00	6
1/4	.60	1.90	6	27/32	2.00	6.25	6
9/32	.65	2.05	6	7/8	2.10	6.50	6
5/16	.70	2.20	6	29/32	2.20	6.75	6
11/32	.75	2.35	6	15/16	2.30	7.25	6
3/8	.80	2.50	6	31/32	2.40	7.75	6
13/32	.85	2.75	6	1"	2.50	8.50	6
7/16	.90	3.00	6	1 1/32	2.60		6
15/32	.95	3.25	6	1 1/16	2.70		6
1/2	1.00	3.50	6	1 1/8	2.90		6
17/32	1.05	3.75	6	1 3/16	3.10		6
9/16	1.10	4.00	6	1 1/4	3.30		6
19/32	1.20	4.25	6	1 5/16	3.60		6
5/8	1.30	4.50	6	1 3/8	3.90		6
21/32	1.40	4.75	6	1 7/16	4.20		6
11/16	1.50	5.00	6	1 1/2	4.50		6

Prentice Drills Six Inch or Short Set No. 155 and No. 555 are regularly furnished with flatted shank.

When so specified Style No. 1, round shank will be furnished at regular prices.

Coes Drills



Style No. 2

Shank 5/8 inch (.647 exact) diameter, 2 1/4 inches long

CARBON STEEL No. 145 **HIGH SPEED STEEL No. 545**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches
1/8	$0.50		4 7/8	21/32	$1.40	$4.75	6
5/32	.55		5 1/8	11/16	1.50	5.00	6
3/16	.60		5 1/2	23/32	1.60	5.25	6
7/32	.65		5 3/4	3/4	1.70	5.50	6
1/4	.70		6	25/32	1.80	5.75	6
9/32	.75		6	13/16	1.90	6.00	6
5/16	.80		6	27/32	2.00	6.25	6
11/32	.85		6	7/8	2.10	6.50	6
3/8	.90		6	29/32	2.20	6.75	6
13/32	.95		6	15/16	2.30	7.25	6
7/16	1.00		6	31/32	2.40	7.75	6
15/32	1.05		6	1"	2.50	8.50	6
1/2	1.10	$3.50	6	1 1/32	2.60	9.25	6
17/32	1.15	3.75	6	1 1/16	2.70	10.00	6
9/16	1.20	4.00	6	1 1/8	2.90	11.25	6
19/32	1.25	4.25	6	1 3/16	3.10	12.50	6
5/8	1.30	4.50	6	1 1/4	3.30	13.75	6

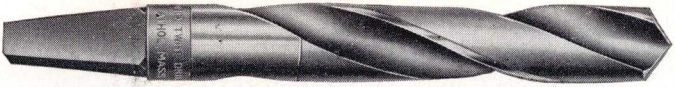
Coes Drills No. 145 and No. 545 are regularly furnished with flatted shank.

When so specified Style No. 1, round shank will be furnished at regular prices.

No. 1 Taper Square Shank Drills

FITTING RATCHETS

No. 1 or Small Shank 3/8 x 5/8 x 1½ inches

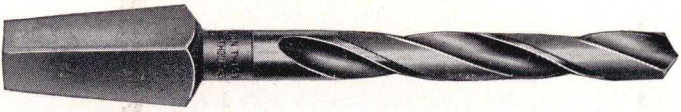


CARBON STEEL No. 135 **HIGH SPEED STEEL No. 535**

No. 2 Taper Square Shank Drills

FITTING RATCHETS

No. 2 or Large Shank ½ x ¾ x 1¾ inches



CARBON STEEL No. 140 **HIGH SPEED STEEL No. 540**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches
1/8	$0.90		4½	21/32	$1.45	$3.30	6½
5/32	.95		4⅝	11/16	1.45	3.40	6½
3/16	.95		4⅞	23/32	1.50	3.50	6½
7/32	1.00		5	3/4	1.55	3.65	6½
1/4	1.00		5	25/32	1.65	3.80	6¾
9/32	1.05		5	13/16	1.75	4.00	7
5/16	1.10		5	27/32	1.90	4.20	7¼
11/32	1.15		5	7/8	2.05	4.50	7½
3/8	1.20		6	29/32	2.20	4.70	7¾
13/32	1.25		6¼	15/16	2.30	5.00	8
7/16	1.25		6¼	31/32	2.40	5.25	8¼
15/32	1.30		6¼	1″	2.55	5.50	8½
1/2	1.30	$2.90	6½	1 1/16	2.85	6.00	9
17/32	1.35	2.95	6½	1 1/8	3.10	6.70	9
9/16	1.35	3.00	6½	1 3/16	3.35	7.30	9
19/32	1.40	3.10	6½	1 1/4	3.65	7.90	9
5/8	1.40	3.20	6½				

No. 1 Shank always furnished unless otherwise specified.

Three and Four Groove Drills or Reamers

WITH MORSE TAPER SHANKS

THREE GROOVE—HIGH SPEED STEEL No. 580

FOUR GROOVE—HIGH SPEED STEEL No. 590

When drilling large holes in solid stock it is advisable to use two or more drills, first using a two groove drill and following with one or more three or four groove drills. Three or four groove drills are especially adapted for enlarging punched, cored or drilled holes.

Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank	Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank
See Note Below x 1/4	$2.75	6 1/8	No. 1	13/16	$ 9.00	10 3/4	No. 3
x 9/32	2.85	6 1/4		27/32	9.50	10 3/4	
x 5/16	2.95	6 3/8		7/8	10.00	10 3/4	
x 11/32	3.05	6 1/2		29/32	10.50	10 3/4	
x 3/8	3.25	6 3/4		15/16	11.00	10 3/4	
x 13/32	3.45	7		31/32	12.00	11	
x 7/16	3.65	7 1/4		1″	12.75	11	
x 15/32	3.85	7 1/2		1 1/32	13.50	11 1/8	
				1 1/16	14.25	11 1/4	
1/2	4.30	8 1/4	No. 2	1 3/32	15.75	12 1/2	No. 4
17/32	4.60	8 1/2		1 1/8	16.75	12 3/4	
9/16	5.10	8 3/4		1 5/32	17.75	12 7/8	
19/32	5.35	8 3/4		1 3/16	18.75	13	
5/8	5.60	8 3/4		1 7/32	19.75	13 1/8	
21/32	6.10	9		1 1/4	21.75	13 1/2	
11/16	6.60	9 1/4		1 9/32	23.75	14 1/8	
23/32	7.10	9 1/2		1 5/16	24.75	14 1/4	
3/4	7.60	9 3/4		1 11/32	25.75	14 3/8	
25/32	8.00	9 7/8					

Sizes marked x are not made in Four Fluted Drills No. 590.
For Sockets and Sleeves see pages 274–275.

List continued on page 197

Three and Four Groove Drills or Reamers—continued

WITH MORSE TAPER SHANKS

THREE GROOVE–HIGH SPEED STEEL No. 580

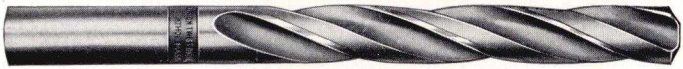
FOUR GROOVE–HIGH SPEED STEEL No. 590

Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank	Diameter Inches	Price Each	Whole Length Inches	Morse Taper Shank
1 3/8	$26.75	14 1/2	No. 4	1 31/32	$59.75	17 3/8	No. 5
1 13/32	28.00	14 5/8		2″	61.50	17 3/8	
1 7/16	29.25	14 3/4		2 1/32	63.25	17 3/8	
1 15/32	30.50	14 7/8		2 1/16	65.00	17 3/8	
1 1/2	31.75	15		2 1/8	68.50	17 3/8	
				2 3/16	72.00	17 3/8	
1 17/32	35.50	16 3/8	No. 5	2 1/4	75.50	17 3/8	
1 9/16	37.50	16 5/8		2 5/16	79.50	17 3/8	
1 19/32	39.50	16 7/8		2 3/8	83.50	17 3/8	
1 5/8	41.00	17		2 7/16	101.50	18 3/4	
1 21/32	42.50	17 1/8		2 1/2	105.00	18 3/4	
1 11/16	44.00	17 1/8		2 9/16	115.50	19 1/2	
1 23/32	45.50	17 1/8		2 5/8	122.00	19 1/2	
1 3/4	47.00	17 1/8		2 11/16	135.00	20 3/8	
1 25/32	48.50	17 1/8		2 3/4	143.00	20 3/8	
1 13/16	50.00	17 1/8		2 13/16	155.00	21 1/8	
1 27/32	51.50	17 1/8		2 7/8	163.00	21 1/8	
1 7/8	54.50	17 3/8		2 15/16	174.00	21 3/4	
1 29/32	56.25	17 3/8		3″	185.00	21 3/4	
1 15/16	58.00	17 3/8					

For Sockets and Sleeves see pages 274–275.

Three and Four Groove Drills or Reamers

WITH STRAIGHT SHANKS



THREE GROOVE

HIGH SPEED STEEL No. 585

FOUR GROOVE

HIGH SPEED STEEL No. 595

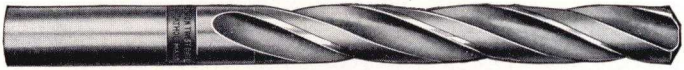
When drilling large holes in solid stock it is advisable to use two or more drills, first using a two groove drill and following with one or more three or four groove drills. Three or four grooved drills are especially adapted for enlarging punched, cored or drilled holes.

Diameter Inches	Price Each High Speed Steel (Three Groove)	Price Each High Speed Steel (Four Groove)	Whole Length Inches
1/4	$2.75	....	6 1/8
9/32	2.85	....	6 1/4
5/16	2.95	....	6 3/8
11/32	3.05	....	6 1/2
3/8	3.25	....	6 3/4
13/32	3.45	....	7
7/16	3.65	....	7 1/4
15/32	3.85	....	7 1/2
1/2	4.05	$4.05	7 3/4
17/32	4.35	4.35	8
9/16	4.80	4.80	8 1/4
19/32	5.35	5.35	8 3/4
5/8	5.60	5.60	8 3/4
21/32	6.10	6.10	9
11/16	6.60	6.60	9 1/4
23/32	7.10	7.10	9 1/2
3/4	7.60	7.60	9 3/4
25/32	8.00	8.00	9 7/8
13/16	8.35	8.35	10
27/32	8.85	8.85	10
7/8	9.30	9.30	10

List continued on page 199

Three and Four Groove Drills or Reamers—continued

WITH STRAIGHT SHANKS



THREE GROOVE

HIGH SPEED STEEL No. 585

FOUR GROOVE

HIGH SPEED STEEL No. 595

Diameter Inches	Price Each High Speed Steel (Three Groove)	Price Each High Speed Steel (Four Groove)	Whole Length Inches
29/32	$ 9.75	$ 9.75	10
15/16	11.00	11.00	10 3/4
31/32	12.00	12.00	11
1″	12.75	12.75	11
1 1/32	13.50	13.50	11 1/8
1 1/16	14.25	14.25	11 1/4
1 3/32	14.50	14.50	11 1/2
1 1/8	15.45	15.45	11 3/4
1 5/32	16.40	16.40	11 7/8
1 3/16	17.30	17.30	12
1 7/32	18.25	18.25	12 1/8
1 1/4	20.15	20.15	12 1/2
1 9/32	23.75	23.75	14 1/8
1 5/16	24.75	24.75	14 1/4
1 11/32	25.75	25.75	14 3/8
1 3/8	26.75	26.75	14 1/2
1 13/32	28.00	28.00	14 5/8
1 7/16	29.25	29.25	14 3/4
1 15/32	30.50	30.50	14 7/8
1 1/2	31.75	31.75	15
1 9/16	34.40	34.40	15 1/4
1 5/8	37.70	37.70	15 5/8
1 11/16	40.45	40.45	15 3/4
1 3/4	44.60	44.60	16 1/4
1 13/16	47.45	47.45	16 1/4
1 7/8	51.75	51.75	16 1/2
1 15/16	55.50	55.50	16 5/8
2″	58.85	58.85	16 5/8

Bit Stock Drills

FOR METAL OR WOOD

CARBON STEEL No. 130

Diameter Inches	Price per Dozen	Whole Length Inches	Diameter Inches	Price per Dozen	Whole Length Inches
1/16	$ 2.50	3 3/8	5/8	$18.00	7 1/2
3/32	2.70	3 5/8	21/32	19.50	7 1/2
1/8	3.00	3 7/8	11/16	21.00	7 1/2
5/32	3.50	4 1/8	23/32	22.50	7 1/2
3/16	4.00	4 3/8	3/4	24.00	7 1/2
7/32	4.50	4 5/8	25/32	25.50	7 1/2
1/4	5.00	5 1/8	13/16	27.00	7 1/2
9/32	6.00	5 1/4	27/32	28.50	7 1/2
5/16	7.00	5 1/2	7/8	30.00	7 1/2
11/32	8.00	5 3/4	29/32	31.50	7 1/2
3/8	8.50	5 7/8	15/16	33.00	7 1/2
13/32	9.25	6	31/32	34.50	7 1/2
7/16	10.50	6 1/4	1"	36.00	7 1/2
15/32	11.75	6 5/8	1 1/16	39.00	7 1/2
1/2	13.00	6 3/4	1 1/8	42.00	7 1/2
17/32	14.25	7 1/2	1 3/16	45.00	7 1/2
9/16	15.50	7 1/2	1 1/4	48.00	7 1/2
19/32	16.75	7 1/2			

Bit Stock Drills may be used in drilling iron, steel or wood.

Will fit any bit brace.

For Bit Stock Drills in sets see pages 214–215.

For Wood Boring Brace Drills see page 201.

Wood Boring Brace Drills

CARBON STEEL No. 133

Will fit any bit brace

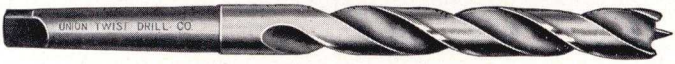
Diameter Inches	Price per Dozen	Whole Length Inches
1/16	$ 3.25	3½
3/32	3.25	4
1/8	3.25	4½
5/32	3.50	5
3/16	4.00	5½
7/32	4.50	6
1/4	5.00	6½
9/32	5.50	7
5/16	6.00	7½
11/32	6.50	7¾
3/8	7.00	8
13/32	7.50	8¼
7/16	8.00	8½
15/32	8.75	8¾
1/2	9.50	9
9/16	11.00	9½
5/8	12.50	9½
11/16	14.50	10
3/4	16.50	10
7/8	21.00	10
1″	27.00	10

For sets of Wood Boring Brace Drills see page 215.

For Bit Stock Drills see page 200.

Taper Shank Machine Bits

FOR WOOD



CARBON STEEL No. 220

Prentice Machine Bits

TAPER LENGTH FOR WOOD—FITTING BLACKSMITHS' DRILL PRESSES

Shank ½ inch diameter. 2½ inches long

CARBON STEEL No. 230

Diameter Inches	Price Each	Whole Length Inches		Morse Taper Shank
		Taper Shank	Prentice	
1/8	$0.50	4 5/8	4 5/8	
5/32	.55	4 7/8	4 7/8	
3/16	.60	5	5	
7/32	.65	5 1/4	5 1/4	
1/4	.70	6 1/8	6 1/8	
9/32	.75	6 1/4	6 1/4	
5/16	.80	6 3/8	6 3/8	
11/32	.85	6 1/2	6 1/2	
3/8	.90	6 3/4	6 3/4	No. 1
13/32	.95	7	7	
7/16	1.00	7 1/4	7 1/4	
15/32	1.10	7 1/2	7 1/2	
1/2	1.20	7 3/4	7 3/4	
17/32	1.30	8	8	
9/16	1.40	8 1/4	8 1/4	
19/32	1.50	8 1/2	8 1/2	
5/8	1.60	8 3/4	8 3/4	
21/32	1.70	9	9	
11/16	1.80	9 1/4	9 1/4	
23/32	1.90	9 1/2	9 1/2	
3/4	2.00	9 3/4	9 3/4	No. 2
25/32	2.10	9 7/8	9 7/8	
13/16	2.20	10	10	
27/32	2.40	10 1/4	10 1/4	
7/8	2.60	10 1/2	10 1/2	
29/32	2.80	10 5/8	10 5/8	
15/16	3.00	10 3/4	10 3/4	
31/32	3.25	10 7/8	10 7/8	
1″	3.50	11	11	
1 1/16	4.00	11 1/4	11 1/4	No. 3
1 1/8	4.50	11 3/4	11 3/4	
1 3/16	5.00	12	12	
1 1/4	5.50	12 1/2	12 1/2	
1 5/16	6.00	14 1/4	12 1/2	
1 3/8	6.50	14 1/2	12 1/2	No. 4
1 7/16	7.50	14 3/4	12 1/2	
1 1/2	8.50	15	12 1/2	

PRENTICE MACHINE BITS No. 230 are regularly furnished with flatted shank. When so specified round shank will be furnished at regular prices.
For Sockets and Sleeves see pages 274–275.

Straight Shank Machine Bits

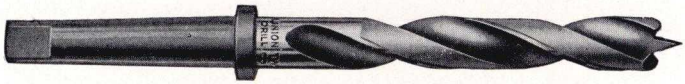
FOR WOOD

CARBON STEEL No. 225

Diameter Inches	Price Each	Whole Length Inches	Length of Flute Inches
1/8	$0.40	3	1 13/16
5/32	.45	3 1/4	2 3/32
3/16	.50	3 1/2	2 5/16
7/32	.55	3 3/4	2 17/32
1/4	.60	4	2 3/4
9/32	.65	4 1/4	2 31/32
5/16	.70	4 1/2	3 3/16
11/32	.75	4 3/4	3 13/32
3/8	.80	5	3 5/8
13/32	.85	5 1/4	3 27/32
7/16	.90	5 1/2	4 1/16
15/32	1.00	5 3/4	4 9/32
1/2	1.10	6	4 1/2
17/32	1.20	6 1/8	4 19/32
9/16	1.30	6 1/4	4 11/16
19/32	1.40	6 3/8	4 3/4
5/8	1.50	6 1/2	4 7/8
21/32	1.60	6 3/4	5
11/16	1.70	7	5 5/16
23/32	1.80	7 1/4	5 1/2
3/4	1.90	7 1/2	5 11/16
25/32	2.00	7 3/4	5 7/8
13/16	2.10	8	6 1/16
27/32	2.30	8 1/4	6 1/4
7/8	2.50	8 1/2	6 7/16
29/32	2.70	8 3/4	6 5/8
15/16	2.90	9	6 13/16
31/32	3.00	9 1/4	7
1″	3.25	9 1/2	7 3/16
1 1/16	3.75	11 1/4	8 1/2
1 1/8	4.25	11 3/4	8 7/8
1 3/16	4.75	12	9
1 1/4	5.25	12 1/2	9 3/8
1 5/16	5.75	12 1/2	9 3/8
1 3/8	6.25	12 1/2	9 3/8
1 7/16	7.25	12 1/2	9 3/8
1 1/2	8.25	12 1/2	9 3/8

McKnight Taper Shank Machine Bits

FOR WOOD



CARBON STEEL No. 221

Diameter Inches	Price Each	Whole Length Inches	Length of Flute Inches
1/8	$0.50	4 3/4	2 3/4
5/32	.55	4 3/4	2 3/4
3/16	.60	4 3/4	2 3/4
7/32	.65	4 3/4	2 3/4
1/4	.65	4 3/4	2 3/4
9/32	.70	4 3/4	2 3/4
5/16	.70	4 3/4	2 3/4
3/8	.80	4 3/4	2 3/4
7/16	.90	4 3/4	2 3/4
1/2	1.00	4 3/4	2 3/4
9/16	1.20	4 3/4	2 3/4
5/8	1.30	4 3/4	2 3/4

Straight Shank Machine Bits

FOR WOOD

Shanks 1/2 inch diameter and 2 inches long

CARBON STEEL No. 222

Diameter Inches	Price Each	Whole Length Inches	Length of Flute Inches	Diameter Inches	Price Each	Whole Length Inches	Length of Flute Inches
1/8	$0.50	5	2 3/8	19/32	$1.25	5	2 3/8
5/32	.55	5	2 3/8	5/8	1.30	5	2 3/8
3/16	.60	5	2 3/8	21/32	1.35	5	2 3/8
7/32	.65	5	2 3/8	11/16	1.40	5	2 3/8
1/4	.65	5	2 3/8	23/32	1.45	5	2 3/8
9/32	.70	5	2 3/8	3/4	1.50	5	2 3/8
5/16	.70	5	2 3/8	25/32	1.60	5	2 3/8
11/32	.75	5	2 3/8	13/16	1.70	5	2 3/8
3/8	.80	5	2 3/8	27/32	1.80	5	2 3/8
13/32	.85	5	2 3/8	7/8	1.90	5	2 3/8
7/16	.90	5	2 3/8	29/32	2.00	5	2 3/8
15/32	.95	5	2 3/8	15/16	2.10	5	2 3/8
1/2	1.00	5	2 3/8	31/32	2.20	5	2 3/8
17/32	1.10	5	2 3/8	1″	2.30	5	2 3/8
9/16	1.20	5	2 3/8				

Bonding Drills

HIGH SPEED STEEL No. 516

These drills are designed for drilling in track circuit signal work.

Diameter Inches	Price per Dozen High Speed Steel	Diameter Shank Inches	Whole Length Inches	Length of Flutes Inches
9/32	$7.00	9/32	3	1 3/4
3/8	11.00	9/32	3	1 3/4
3/8	11.00	3/8	3	1 3/4

Tell-Tale Drills

SHORT LENGTH

CARBON STEEL No. 117 **HIGH SPEED STEEL No. 517**

For drilling tell-tale holes in stay bolts.

Diameter Inches	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Whole Length Inches	Length of Flutes Inches
3/16	$2.25	$4.85	3 1/2	1 3/4
7/32	2.75	5.75	3 3/4	1 3/4

Tell-Tale Drills

LONG LENGTH

CARBON STEEL No. 127 **HIGH SPEED STEEL No. 527**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches
3/16	$0.50	$1.25	5 1/2	3 1/2
7/32	.55	1.35	5 1/2	3 1/2

Straight Fluted Drills

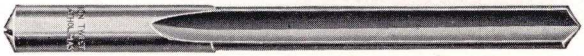
STRAIGHT SHANK—JOBBERS' LENGTH

CARBON STEEL No. 210

Carried in stock in sizes 1/16 inch to 1/2 inch by 64ths.
Prices on application.

Straight Fluted Drills

STRAIGHT SHANK—WIRE GAUGE SIZES



CARBON STEEL No. 215

Carried in stock in Wire Gauge sizes No. 1 to No. 60.
Prices on application.

Left Hand Drills

STRAIGHT SHANK—JOBBERS' LENGTH

CARBON STEEL No. 260 **HIGH SPEED STEEL No. 660**

Carried in stock in sizes 1/16 inch to 1/2 inch by 64ths.
Prices on application.

Left Hand Drills

STRAIGHT SHANK—WIRE GAUGE SIZES

CARBON STEEL No. 265 **HIGH SPEED STEEL No. 665**

Carried in stock in Wire Gauge sizes No. 1 to No. 60.
Prices on application.

Single Flute Drills for Wood

CARBON STEEL No. 305 **HIGH SPEED STEEL No. 805**

These drills are carried in stock, straight shank Jobbers' Lengths 1/16 inch to 1/2 inch by 64ths, and straight shank Wire Gauge sizes No. 1 to No. 60.

Prices on application.

Threaded Shank Drills

CARBON STEEL No. 320

Threaded Shank Drills are especially designed for drilling gas stove burners. Regular sizes carried in stock.

Prices on application.

Double Grooved Shank Drills

Fitting Graham Chucks

JOBBERS' LENGTH

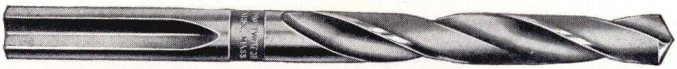
CARBON STEEL No. 165 **HIGH SPEED STEEL No. 565**

Prices on application.

Double Grooved Shank Drills

Fitting Graham Chucks

TAPER LENGTH



CARBON STEEL No. 160 **HIGH SPEED STEEL No. 560**

Prices on application.

Drills for Brass

CARBON STEEL

STRAIGHT SHANK JOBBERS' LENGTH No. 321
STRAIGHT SHANK WIRE GAUGE No. 324

These drills are carried in stock in sizes 1/16 inch to 1/2 inch by 64ths, and Wire Gauge sizes No. 1 to No. 60.
For list prices see pages 187–189.

CARBON STEEL No. 319 **HIGH SPEED STEEL No. 519**

Prices on Application.

Drills for Bakelite

CARBON STEEL No. 322 **HIGH SPEED STEEL No. 622**

STYLE NO. 1

For drilling thin sections

CARBON STEEL No. 323 **HIGH SPEED STEEL No. 623**

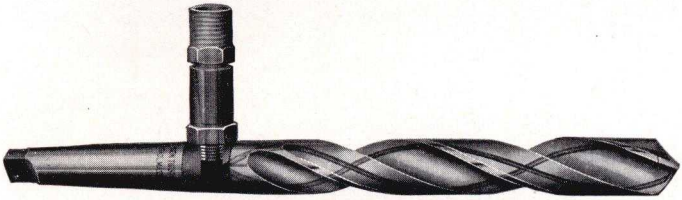
STYLE NO. 2

For drilling thicker sections and deep drilling.
High Speed Steel Drills for Bakelite Styles Nos. 1 and 2 are furnished in sizes 1/16 inch to 1/2 inches by 64ths, and Wire Gauge sizes No. 1 to No. 60. For list prices see pages 187–189.
Carbon Steel Drills for Bakelite—Prices on application.

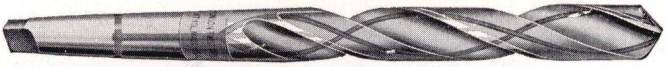
Oil Hole Drills

With Oil Holes through the Solid Metal for Lubricant

CARBON STEEL AND

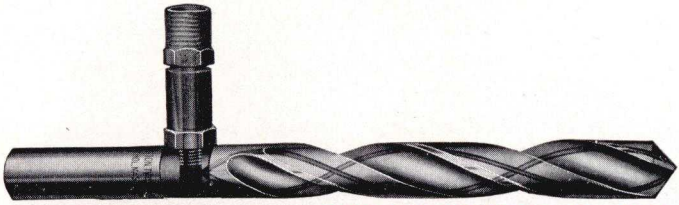


CARBON STEEL No. 170 HIGH SPEED STEEL No. 1170



CARBON STEEL No. 171 HIGH SPEED STEEL No. 1171

CARBON STEEL No. 172 HIGH SPEED STEEL No. 1172



CARBON STEEL No. 173 HIGH SPEED STEEL No. 1173

CARBON STEEL No. 174 HIGH SPEED STEEL No. 1174

CARBON STEEL No. 176 HIGH SPEED STEEL No. 1176

Prices all Styles Furnished on Application
Specify which number is wanted

Sets of Taper Shank Drills

CARBON STEEL

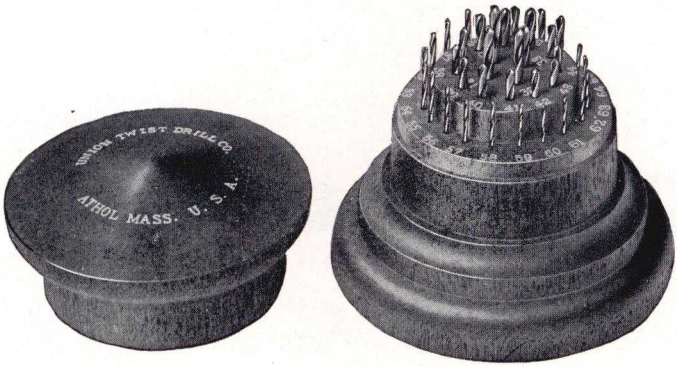
No. 1.	Set of Taper Shank Drills, 1/4 to 1 inch by 16ths . . .	$ 22.40
No. 2.	Set of Taper Shank Drills, 3/8 to 1 1/4 inches by 16ths	40.10
No. 3.	Set of Taper Shank Drills, 3/8 to 3/4 inch by 32ds, 13/16 to 1 1/4 inches by 16ths	48.50
No. 4.	Set of Taper Shank Drills, 3/8 to 3/4 inch by 32ds, 13/16 to 2 inches by 16ths	186.00
No. 11.	Set of Taper Shank Drills, 3/8 to 2 inches by 32ds. . .	345.30

NOTE: Taper Shank Drills are listed on pages 181–182.

NOTE: Prices of sets of Straight Shank Taper Length Drills will be the same as above list.

Jewelers' Set of Drills

CARBON STEEL



(Mounted in Mahogany box)

No. 10.	Jewelers' Set of 36 Drills, Wire Gauge sizes Nos. 30 to No. 65, mounted in a box with cap	$9.50
	Jewelers' Case without Drills	3.50

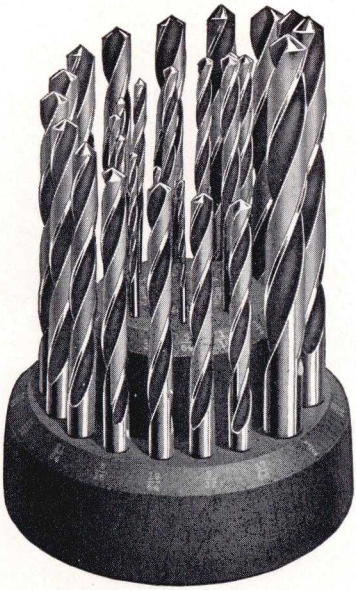
NOTE: Wire Gauge Drills are listed on pages 188–189.

Continued on page 211

Sets of Straight Shank Drills

JOBBERS' LENGTH

CARBON STEEL



WITH WOOD STAND

No. 5.	Set of Jobbers' Drills 1/16 to 1/2 inch by 64ths.....	$15.00
No. 6.	Set of Jobbers' Drills 1/16 to 1/2 inch by 32ds.....	9.50
No. 7.	Set of Jobbers' and Wire Gauge Drills 1/4 to 3/8 inch by 32ds and Nos. 1-60. 65 Drills.....	15.75
Stand without Drills for above Sets.....		2.50
No. 22.	Set of Jobbers' Drills 1/16 to 3/16 inch by 64ths, contained in convenient pocket size package	1.60
No. 25.	Set of Jobbers' Drills 5/32 to 5/16 inch by 32ds, and Wire Gauge Drills Nos. 19, 29 and 33 contained in Cardboard box.....	2.10

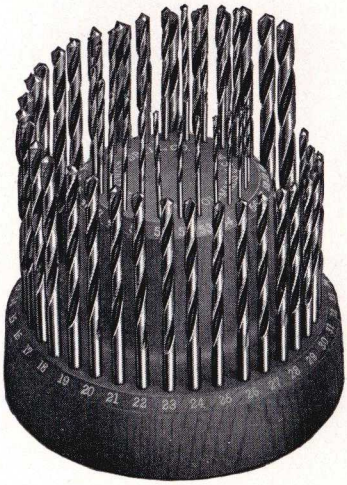
NOTE: Jobbers' Length Drills are listed on page 187.

Continued on page 212

Sets of Straight Shank Drills

WIRE GAUGE AND LETTER SIZES

CARBON STEEL



WITH WOOD STAND

No. 8.	Set of Wire Gauge Sizes, No. 1 to No. 60.....	$13.35
No. 9.	Half Set Wire Gauge Sizes, alternate numbers from No. 1 to No. 59.....	8.50
No. 15.	Set of Letter Sizes, A to Z.....	13.50
No. 17.	Set of Wire Gauge Sizes, No. 1 to No. 80.....	15.25
Stands without Drills for Sets Nos. 8, 9, 15, 17.....		2.50

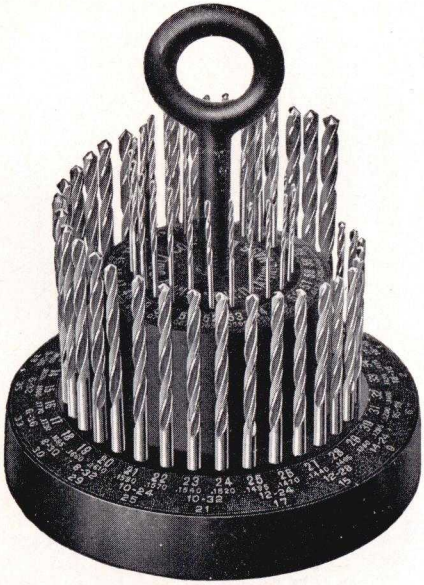
NOTE: Wire Gauge Drills are listed on pages 188-189. Letter Size Drills are listed on page 191.

Continued on page 213

Sets of Straight Shank Drills

WIRE GAUGE AND JOBBERS' LENGTH

CARBON STEEL AND HIGH SPEED STEEL



WITH METAL STAND

No. 18.	Set of Jobbers' Drills 1/16″ to 1/2″ by 64ths	$16.00
No. 19.	Set of Wire Gauge Sizes. No. 1 to No. 60	14.35
No. 18½.	Set of Jobbers' Drills 1/16″ to 1/2″ by 64ths, High Speed Steel, without Stand	24.75
No. 19½.	Set of Wire Gauge Sizes, No. 1 to No. 60, High Speed Steel without Stand	18.85
Stands without Drills for Sets Nos. 18, 19, 18½, 19½		3.50

These stands are practically indestructible and have many special features in the saving of time.

Each hole is stamped with size of drill, also the decimal equivalent, and the base of No. 19 Set Stand with Tap Drill Sizes.

The handle may be removed and screwed in the inside of Stand for convenience in storing in tool box or shipping.

NOTE: Wire Gauge Drills are listed on pages 188–189. Jobbers' Length Drills are listed on page 187.

Sets of Bit Stock Drills

SET No. 13

This set consists of the following Bit Stock Drills: 1/16″, 3/32″, 1/8″, 5/32″, 3/16″, 7/32″, 1/4″, 5/16″, 3/8″.

Furnished in a round, polished, wood box.

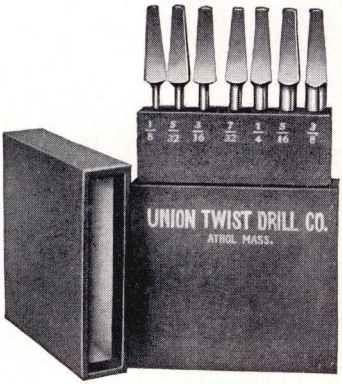
Price, $4.25

SET No. 14

This set consists of the following Bit Stock Drills: 1/16″, 3/32″, 1/8″, 5/32″, 3/16″, 7/32″, 1/4″.

Furnished in a round, polished, wood box similar to No. 13.

Price, $2.70



SET No. 14A

This set consists of the following Bit Stock Drills: 1/8″, 5/32″, 3/16″, 7/32″, 1/4″, 5/16″, 3/8″.

Furnished in a neat, flat, leatherette case, of a size suitable for carrying in the pocket.

Price, $4.35

NOTE: Bit Stock Drills are listed on page 200.

Bit Stock Drill and Reamer Set

SET No. 20

This set consists of the following: Bit Stock Drills 1/4", 5/16", 3/8", 1/2" and 1 Taper Square Reamer Bit. Price, $4.80.

NOTE: Bit Stock Drills are listed on page 200.

Wood Boring Brace Drill Sets

SET No. 133A

This set consists of the following: Wood Boring Brace Drills 1/8", 5/32", 3/16", 7/32", 1/4", 5/16", and 3/8".

Furnished in neat flat, leatherette case. Price, $3.70.

SET No. 133B

This set consists of the following: Wood Boring Brace Drills 1/16", 3/32", 1/8", 5/32", 3/16", 7/32", 1/4", 5/16", and 3/8".

Furnished in round, polished, wood box. Price, $4.50.

NOTE: Wood Boring Brace Drills are listed on page 201.

Combined Drill and Countersink Set

SET No. 21

Set consists of following sizes: 3/64", 1/16", 5/64", 3/32", 1/8", 5/32", 3/16".

Furnished in round, polished, wood box.

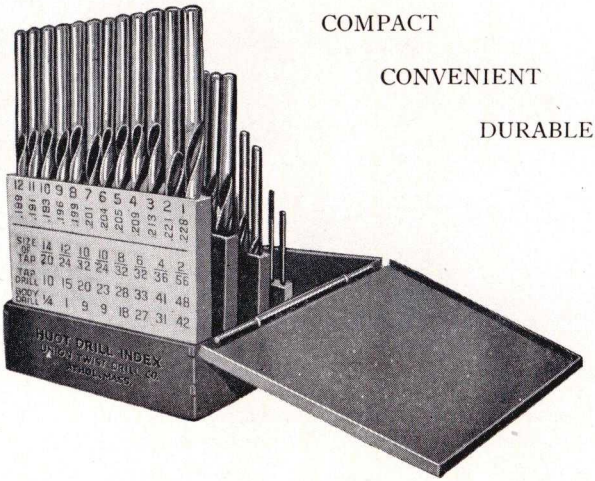
Price Set including Box, $2.80

NOTE: Combined Drills and Countersinks are listed on page 183.

Sets of Straight Shank Drills

WIRE GAUGE AND JOBBERS' LENGTH WITH INDEX CONTAINERS

Index Containers are Cadmium Steel Plated.
Holes in Panels are Individually Drilled.
Drill Sizes, Decimal Equivalents and Tap Sizes are plainly marked on panels.
Panels are hinged and fold into box.



COMPACT

CONVENIENT

DURABLE

Outside Dimensions

Index Nos. 118-218	4″	wide	7″	long	1¾″	deep
Index Nos. 119-219	3¼″	wide	4½″	long	1″	deep

SETS COMPLETE WITH INDEX CONTAINERS

SET No. 118.	Carbon Steel Jobbers' Length Drills 1/16″ to ½″ by 64ths	$16.00
SET No. 119.	Carbon Steel Wire Gauge Drills No. 1 to No. 60	14.35
SET No. 218.	High Speed Steel Jobbers' Length Drills 1/16″ to ½″ by 64ths	27.70
SET No. 219.	High Speed Steel Wire Gauge Drills No. 1 to No. 60	21.80

Twist Drills—Metric

SECTION INDEX

Pages

Taper Shank—Regular Shanks 218–221, 224–227

Taper Shank—Shanks Smaller Than Regular 222–223

Straight Shank, Taper Length 228–229

Straight Shank, Jobbers' Length 230–233

Taper Shank Twist Drills

METRIC SIZES

HIGH SPEED STEEL No. 1270

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
3	$1.00	.1181	130	No. 1
3½	1.10	.1378	136	
4	1.15	.1575	136	
4½	1.25	.1772	146	
5	1.35	.1968	152	
5½	1.35	.2165	152	
6	1.40	.2362	155	
6½	1.45	.2559	155	
7	1.50	.2756	159	
7½	1.60	.2953	162	
8	1.70	.3150	162	
8½	1.70	.3346	165	
9	1.90	.3543	171	
9½	1.90	.3740	171	
10	2.10	.3937	178	
10½	2.30	.4134	184	
11	2.30	.4331	184	
11½	2.50	.4528	190	
12	2.70	.4724	190	
12½	2.95	.4921	210	No. 2
13	3.25	.5118	216	
13½	3.65	.5315	216	
14	3.75	.5512	222	

For Sockets and Sleeves see pages 274–275.

List continued on page 219

Taper Shank Twist Drills—continued

METRIC SIZES

HIGH SPEED STEEL No. 1270

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
14½	$ 4.00	.5709	222	
15	4.00	.5905	222	
15½	4.25	.6102	222	
16	4.60	.6299	222	
16½	4.75	.6496	229	
17	5.25	.6693	235	No. 2
17½	5.75	.6890	235	
18	5.75	.7087	241	
18½	6.25	.7283	248	
19	6.25	.7480	248	
19½	6.50	.7677	251	
20	7.25	.7874	273	
20½	7.25	.8071	273	
21	7.65	.8268	273	
21½	8.05	.8465	273	
22	8.05	.8661	273	
22½	8.45	.8858	273	
23	8.45	.9055	273	
23½	8.85	.9252	273	No. 3
24	9.65	.9449	279	
24½	9.65	.9646	279	
25	10.25	.9842	279	
25½	11.00	1.0039	279	
26	11.00	1.0236	283	
26½	11.75	1.0433	286	
27	12.20	1.0630	286	
27½	13.25	1.0827	317	
28	14.25	1.1024	324	
28½	14.25	1.1220	324	No. 4
29	15.00	1.1417	327	
29½	15.75	1.1614	330	

For Sockets and Sleeves see pages 274–275.

List continued on page 220

Taper Shank Twist Drills—continued

METRIC SIZES

HIGH SPEED STEEL No. 1270

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
30	$15.75	1.1811	330	
30½	16.50	1.2008	333	
31	18.00	1.2205	333	
31½	18.00	1.2402	343	
32	20.00	1.2598	359	
32½	20.00	1.2795	359	
33	20.75	1.2992	362	
33½	21.50	1.3189	365	
34	21.50	1.3386	365	No. 4
34½	22.25	1.3583	368	
35	23.00	1.3779	368	
35½	23.00	1.3976	372	
36	23.75	1.4173	375	
36½	23.75	1.4370	375	
37	24.50	1.4567	378	
37½	25.25	1.4764	381	
38	25.25	1.4961	381	
38½	28.75	1.5157	416	
39	30.75	1.5354	422	
39½	30.75	1.5551	422	
40	32.75	1.5748	428	
40½	34.00	1.5955	428	
41	34.00	1.6142	431	
41½	35.25	1.6339	435	
42	35.25	1.6535	435	No. 5
42½	36.50	1.6732	435	
43	37.75	1.6929	435	
43½	37.75	1.7126	435	
44	39.00	1.7323	435	
44½	40.25	1.7520	435	
45	40.25	1.7716	435	

For Sockets and Sleeves see pages 274–275.

List continued on page 221

Taper Shank Twist Drills—continued

METRIC SIZES

HIGH SPEED STEEL No. 1270

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
46	$ 41.50	1.8110	435	
47	45.00	1.8504	441	
48	46.25	1.8898	441	
49	47.50	1.9291	441	
50	48.75	1.9685	441	
51	51.75	2.0079	441	
52	53.50	2.0472	441	
53	55.25	2.0866	441	
54	58.75	2.1260	441	
55	60.50	2.1653	441	
56	62.25	2.2047	441	
57	64.00	2.2441	441	
58	67.50	2.2835	441	
59	71.00	2.3228	441	
60	71.00	2.3622	441	
61	87.50	2.4016	476	No. 5
62	91.00	2.4409	476	
63	91.00	2.4803	476	
64	100.00	2.5197	495	
65	100.00	2.5590	495	
66	105.00	2.5984	495	
67	110.55	2.6378	495	
68	115.50	2.6772	517	
69	120.50	2.7165	517	
70	125.65	2.7559	517	
71	129.50	2.7953	537	
72	135.00	2.8346	537	
73	135.00	2.8740	537	
74	142.50	2.9134	552	
75	150.00	2.9527	552	
76	150.00	2.9921	552	

For Sockets and Sleeves see pages 274–275.

Taper Shank Twist Drills

With Shanks Smaller Than Regular

METRIC SIZES

HIGH SPEED STEEL No. 1272

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
12½	$ 2.75	.4921	197	No. 1
13	3.05	.5118	203	
13½	3.40	.5315	203	
14	3.50	.5512	210	
20	6.75	.7874	254	No. 2
20½	6.75	.8071	254	
21	7.15	.8268	254	
21½	7.50	.8465	254	
22	7.50	.8661	254	
22½	7.85	.8858	254	
23	7.85	.9055	254	
27½	12.20	1.0827	292	No. 3
28	13.15	1.1024	298	
28½	13.15	1.1220	298	
29	13.85	1.1417	301	
29½	14.55	1.1614	301	

For Sockets and Sleeves see pages 274–275.

List continued on page 223

Taper Shank Twist Drills—continued

With Shanks Smaller Than Regular

METRIC SIZES

HIGH SPEED STEEL No. 1272

Diameter mm.	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
30	$14.55	1.1811	305	No. 3
30½	15.25	1.2008	308	
31	16.65	1.2205	308	
31½	16.65	1.2402	317	
38½	26.35	1.5157	381	No. 4
39	28.20	1.5354	381	
39½	28.20	1.5551	387	
40	30.10	1.5748	394	
40½	31.25	1.5955	394	
41	31.25	1.6142	397	
41½	32.40	1.6339	400	
42	32.40	1.6535	400	
42½	33.55	1.6732	400	
43	34.70	1.6929	400	
43½	34.70	1.7126	400	
44	37.00	1.7323	413	
44½	38.20	1.7520	413	
45	38.20	1.7716	413	
46	39.40	1.8110	413	
47	42.75	1.8504	419	
48	43.95	1.8898	419	
49	45.45	1.9291	422	
50	46.65	1.9685	422	

For Sockets and Sleeves see pages 274–275.

Taper Shank Twist Drills

METRIC SIZES

CARBON STEEL No. 270

Diameter mm.	Price Each Carbon Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
3	$0.45	.1181	130	
3½	.45	.1378	136	
4	.50	.1575	136	
4½	.50	.1772	146	
5	.55	.1968	152	
5½	.55	.2165	152	
6	.60	.2362	155	
6½	.65	.2559	155	
7	.65	.2756	159	
7½	.70	.2953	162	
8	.75	.3150	162	
8½	.75	.3346	165	No. 1
9	.80	.3543	171	
9½	.80	.3740	171	
10	.90	.3937	178	
10½	1.00	.4134	184	
11	1.00	.4331	184	
11½	1.10	.4528	190	
12	1.20	.4724	190	
12½	1.20	.4921	197	
13	1.30	.5118	203	
13½	1.40	.5315	203	
14	1.40	.5512	210	

For Sockets and Sleeves see pages 274–275.

List continued on page 225

Taper Shank Twist Drills—continued

METRIC SIZES

CARBON STEEL No. 270

Diameter mm.	Price Each Carbon Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
14½	$1.50	.5709	222	
15	1.50	.5905	222	
15½	1.60	.6102	222	
16	1.70	.6299	222	
16½	1.70	.6496	229	
17	1.80	.6693	235	
17½	1.90	.6890	235	
18	1.90	.7087	241	
18½	2.00	.7283	248	No. 2
19	2.00	.7480	248	
19½	2.10	.7677	251	
20	2.20	.7874	254	
20½	2.20	.8071	254	
21	2.40	.8268	254	
21½	2.60	.8465	254	
22	2.60	.8661	254	
22½	2.80	.8858	254	
23	2.80	.9055	254	
23½	3.00	.9252	273	
24	3.25	.9449	279	
24½	3.25	.9646	279	
25	3.50	.9842	279	
25½	3.75	1.0039	279	
26	3.75	1.0236	283	
26½	4.00	1.0433	286	No. 3
27	4.25	1.0630	286	
27½	4.25	1.0827	292	
28	4.50	1.1024	298	
28½	4.50	1.1220	298	
29	4.75	1.1417	301	
29½	5.00	1.1614	301	

For Sockets and Sleeves see pages 274–275.

List continued on page 226

Taper Shank Twist Drills—continued

METRIC SIZES

CARBON STEEL No. 270

Diameter mm.	Price Each Carbon Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
30	$5.00	1.1811	305	No. 3
30½	5.25	1.2008	308	
31	5.50	1.2205	308	
31½	5.50	1.2402	317	
32	5.75	1.2598	359	No. 4
32½	5.75	1.2795	359	
33	6.00	1.2992	362	
33½	6.25	1.3189	365	
34	6.25	1.3386	365	
34½	6.50	1.3583	368	
35	7.00	1.3779	368	
35½	7.00	1.3976	372	
36	7.50	1.4173	375	
36½	7.50	1.4370	375	
37	8.00	1.4567	378	
37½	8.50	1.4764	381	
38	8.50	1.4961	381	
38½	9.00	1.5157	381	
39	9.50	1.5354	381	
39½	9.50	1.5551	387	
40	10.00	1.5748	394	
40½	10.50	1.5955	394	
41	10.50	1.6142	397	
41½	11.00	1.6339	400	
42	11.00	1.6535	400	
42½	11.50	1.6732	400	
43	12.00	1.6929	400	
43½	12.00	1.7126	400	
44	12.50	1.7323	413	
44½	13.25	1.7520	413	
45	13.25	1.7716	413	

For Sockets and Sleeves see pages 274–275.

List continued on page 227

Taper Shank Twist Drills—continued

METRIC SIZES

CARBON STEEL No. 270

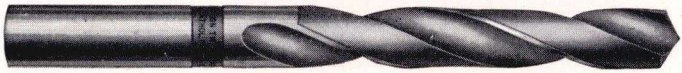
Diameter mm.	Price Each Carbon Steel	Decimal Equivalent	Whole Length mm.	Morse Taper Shank
46	$14.00	1.8110	413	
47	15.50	1.8504	419	
48	16.25	1.8898	419	No. 4
49	17.00	1.9291	422	
50	17.75	1.9685	422	
51	19.25	2.0079	441	
52	20.00	2.0472	441	
53	20.75	2.0866	441	
54	22.25	2.1260	441	
55	23.00	2.1653	441	
56	23.75	2.2047	441	
57	24.50	2.2441	441	
58	26.00	2.2835	441	
59	26.75	2.3228	441	
60	27.50	2.3622	441	
61	28.25	2.4016	476	
62	29.75	2.4409	476	
63	30.50	2.4803	476	No. 5
64	31.25	2.5197	495	
65	32.00	2.5590	495	
66	34.00	2.5984	495	
67	35.00	2.6378	495	
68	36.00	2.6772	517	
69	37.00	2.7165	517	
70	39.25	2.7559	517	
71	40.50	2.7953	537	
72	41.75	2.8346	537	
73	43.00	2.8740	537	
74	45.50	2.9134	552	
75	46.75	2.9527	552	
76	48.00	2.9921	552	

For Sockets and Sleeves see pages 274–275.

Straight Shank Twist Drills

TAPER LENGTH

METRIC SIZES



CARBON STEEL No. 275 **HIGH SPEED STEEL No. 1275**

Diameter mm.	Price Each Carbon Steel	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.
3	$0.45	$1.00	.1181	130
3½	.45	1.10	.1378	136
4	.50	1.15	.1575	136
4½	.50	1.25	.1772	146
5	.55	1.35	.1968	152
5½	.55	1.35	.2165	152
6	.60	1.40	.2362	155
6½	.65	1.45	.2559	155
7	.65	1.50	.2756	159
7½	.70	1.60	.2953	162
8	.75	1.70	.3150	162
8½	.75	1.70	.3346	165
9	.80	1.90	.3543	171
9½	.80	1.90	.3740	171
10	.90	2.10	.3937	178
10½	1.00	2.30	.4134	184
11	1.00	2.30	.4331	184
11½	1.10	2.50	.4528	190
12	1.20	2.70	.4724	190
12½	1.20	2.75	.4921	197
13	1.30	3.05	.5118	203
13½	1.40	3.40	.5315	203
14	1.40	3.50	.5512	210
14½	1.50	4.00	.5709	222
15	1.50	4.00	.5905	222
15½	1.60	4.25	.6102	222
16	1.70	4.60	.6299	222
16½	1.70	4.75	.6496	229
17	1.80	5.25	.6693	235
17½	1.90	5.75	.6890	235
18	1.90	5.75	.7087	241
18½	2.00	6.25	.7283	248
19	2.00	6.25	.7480	248
19½	2.10	6.50	.7677	251
20	2.20	6.75	.7874	254
20½	2.20	6.75	.8071	254
21	2.40	7.15	.8268	254
21½	2.60	7.50	.8465	254

List continued on page 229

Straight Shank Twist Drills—continued

TAPER LENGTH

METRIC SIZES

CARBON STEEL No. 275 **HIGH SPEED STEEL No. 1275**

Diameter mm.	Price Each Carbon Steel	Price Each High Speed Steel	Decimal Equivalent	Whole Length mm.
22	$ 2.60	$ 7.50	.8661	254
22½	2.80	7.85	.8858	254
23	2.80	7.85	.9055	254
23½	3.00	8.85	.9252	273
24	3.25	9.65	.9449	279
24½	3.25	9.65	.9646	279
25	3.50	10.25	.9842	279
25½	3.75	11.00	1.0039	279
26	3.75	11.00	1.0236	283
26½	4.00	11.75	1.0433	286
27	4.25	12.20	1.0630	286
27½	4.25	12.20	1.0827	292
28	4.50	13.15	1.1024	298
28½	4.50	13.15	1.1220	298
29	4.75	13.85	1.1417	301
29½	5.00	14.55	1.1614	301
30	5.00	14.55	1.1811	305
31	5.50	16.65	1.2205	308
32	5.75	20.00	1.2598	359
33	6.00	20.75	1.2992	362
34	6.25	21.50	1.3386	365
35	7.00	23.00	1.3779	368
36	7.50	23.75	1.4173	375
37	8.00	24.50	1.4567	378
38	8.50	25.25	1.4961	381
39	9.50	28.20	1.5354	381
40	10.00	30.10	1.5748	394
41	10.50	31.25	1.6142	397
42	11.00	32.40	1.6535	400
43	12.00	34.70	1.6929	400
44	12.50	37.00	1.7323	413
45	13.25	38.20	1.7716	413
46	14.00	39.40	1.8110	413
47	15.50	42.75	1.8504	419
48	16.25	43.95	1.8898	419
49	17.00	45.45	1.9291	422
50	17.75	46.65	1.9685	422

Straight Shank Twist Drills

WIRE AND JOBBERS' LENGTHS

METRIC SIZES

CARBON STEEL No. 280 **HIGH SPEED STEEL No. 1280**

Diameter mm.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length mm.
.35	$1.50	$4.25	.0138	19
.40	1.50	4.25	.0158	22
.45	1.50	4.25	.0177	24
.50	1.50	4.25	.0197	25
.55	1.50	4.25	.0217	27
.60	1.50	4.25	.0236	30
.65	1.50	4.25	.0256	32
.70	1.50	3.50	.0276	33
.75	1.50	3.50	.0295	35
.80	1.50	3.50	.0315	37
.85	1.50	3.50	.0335	38
.90	1.50	3.50	.0354	38
.95	1.50	3.50	.0374	38
1.00	1.50	3.50	.0394	38
1.05	1.55	2.40	.0413	40
1.10	1.55	2.40	.0433	43
1.15	1.55	2.40	.0453	43
1.20	1.55	2.40	.0472	43
1.25	1.55	2.40	.0492	43
1.30	1.60	2.40	.0512	44
1.35	1.60	2.40	.0531	44
1.40	1.60	2.40	.0551	46
1.45	1.60	2.40	.0571	46
1.50	1.60	2.40	.0591	46
1.55	1.60	2.40	.0610	46
1.60	1.60	2.40	.0630	48
1.65	1.60	2.40	.0650	48
1.70	1.60	2.40	.0669	49
1.75	1.60	2.40	.0689	49
1.80	1.65	2.40	.0709	49
1.85	1.65	2.50	.0728	51
1.90	1.65	2.50	.0748	52
1.95	1.65	2.50	.0768	52
2.00	1.65	2.50	.0787	52

List continued on page 231

Straight Shank Twist Drills—continued

WIRE AND JOBBERS' LENGTHS

METRIC SIZES

CARBON STEEL No. 280 **HIGH SPEED STEEL No. 1280**

Diameter mm.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length mm.
2.05	$1.65	$2.50	.0807	54
2.10	1.70	2.60	.0827	56
2.15	1.70	2.60	.0846	56
2.20	1.70	2.60	.0866	56
2.25	1.70	2.60	.0886	57
2.30	1.70	2.60	.0906	57
2.35	1.70	2.75	.0925	59
2.40	1.70	2.80	.0945	59
2.45	1.70	2.80	.0965	59
2.50	1.75	2.80	.0984	60
2.60	1.75	2.95	.1024	62
2.70	1.75	3.10	.1063	65
2.75	1.75	3.10	.1083	65
2.80	1.75	3.15	.1102	65
2.90	1.75	3.30	.1142	68
3.00	1.75	3.30	.1181	70
3.10	1.75	3.30	.1220	70
3.20	1.80	3.60	.1260	71
3.25	1.80	3.60	.1279	71
3.30	1.80	3.60	.1299	71
3.40	1.80	3.60	.1339	71
3.50	1.80	3.60	.1378	71
3.60	1.80	3.60	.1417	73
3.70	1.80	3.90	.1457	75
3.75	1.80	3.90	.1476	75
3.80	1.90	3.90	.1496	76
3.90	1.90	4.05	.1535	78
4.00	1.90	4.15	.1575	79
4.10	2.00	4.35	.1614	81
4.20	2.00	4.35	.1654	83
4.25	2.00	4.35	.1673	83
4.30	2.00	4.50	.1693	84
4.40	2.00	4.65	.1732	84
4.50	2.00	4.85	.1772	86
4.60	2.25	4.85	.1811	87
4.70	2.25	4.85	.1850	89

List continued on page 232

Straight Shank Twist Drills—continued

WIRE AND JOBBERS' LENGTHS

METRIC SIZES

CARBON STEEL No. 280 **HIGH SPEED STEEL No. 1280**

Diameter mm.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length mm.
4.75	$2.25	$4.85	.1870	89
4.80	2.25	5.25	.1890	90
4.90	2.50	5.25	.1929	92
5.00	2.50	5.45	.1969	94
5.10	2.50	5.45	.2008	95
5.20	2.50	5.95	.2047	97
5.25	2.75	5.95	.2067	97
5.30	2.75	5.95	.2087	98
5.40	2.75	5.95	.2126	98
5.50	2.75	5.95	.2165	98
5.60	2.75	6.25	.2205	98
5.70	2.75	6.25	.2244	98
5.75	2.75	6.25	.2264	98
5.80	2.75	6.25	.2283	98
5.90	3.00	6.25	.2323	98
6.00	3.05	6.55	.2362	98
6.10	3.10	6.55	.2402	98
6.20	3.15	6.75	.2441	102
6.25	3.15	6.75	.2461	102
6.30	3.25	6.75	.2480	102
6.40	3.25	7.25	.2520	102
6.50	3.35	7.50	.2559	105
6.60	3.45	7.50	.2598	105
6.70	3.45	7.50	.2638	105
6.75	3.50	7.50	.2657	105
6.80	3.50	8.00	.2677	105
6.90	3.65	8.00	.2717	105
7.00	3.70	8.00	.2756	105
7.10	3.80	8.25	.2795	108
7.20	3.80	8.75	.2835	108
7.25	3.80	8.75	.2854	108
7.30	3.80	8.75	.2874	108
7.40	3.90	8.75	.2913	108
7.50	4.00	9.00	.2953	111
7.60	4.00	9.50	.2992	111

List continued on page 233

Straight Shank Twist Drills—continued

WIRE AND JOBBERS' LENGTHS

METRIC SIZES

CARBON STEEL No. 280 **HIGH SPEED STEEL No. 1280**

Diameter mm.	Price per Dozen Carbon Steel	Price per Dozen High Speed Steel	Decimal Equivalent	Whole Length mm.
7.70	$ 4.25	$ 9.50	.3031	111
7.75	4.25	9.50	.3051	111
7.80	4.25	9.50	.3071	111
7.90	4.35	9.75	.3110	114
8.00	4.40	10.45	.3150	114
8.10	4.40	10.45	.3189	114
8.20	4.60	10.75	.3228	117
8.25	4.60	10.75	.3248	117
8.30	4.70	10.75	.3268	117
8.40	4.75	11.75	.3307	121
8.50	4.75	11.75	.3346	121
8.60	5.00	11.75	.3386	121
8.70	5.05	11.75	.3425	121
8.75	5.05	11.75	.3445	121
8.80	5.15	12.75	.3465	124
8.90	5.15	12.75	.3504	124
9.00	5.50	12.75	.3543	124
9.10	5.50	12.75	.3583	124
9.20	5.50	13.40	.3622	124
9.25	5.50	13.75	.3642	127
9.30	5.50	13.75	.3661	127
9.40	6.00	13.75	.3701	127
9.50	6.00	13.75	.3740	127
9.60	6.00	14.65	.3780	127
9.70	6.50	15.00	.3819	130
9.75	6.50	15.00	.3839	130
9.80	6.50	15.00	.3858	130
9.90	6.50	15.00	.3898	130
10.00	6.75	15.85	.3937	130
10.50	7.25	17.10	.4134	133
11.00	8.50	18.75	.4331	140
11.50	9.25	20.00	.4528	143
12.00	10.00	22.25	.4724	146
12.50	11.00	24.25	.4921	150
13.00	12.00	26.50	.5118	152

UNION

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Reamers

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Reamers

CARBON AND HIGH SPEED STEEL

In this catalog we show lists and sizes of Reamers most commonly used and which we regularly carry in stock.

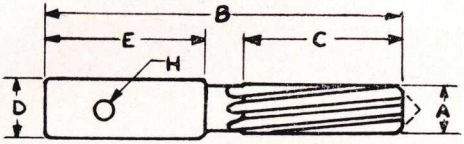
It is difficult to say just what type of Reamer should be used on different materials and different classes of work, as tolerance, material and other conditions must be considered. As Reamers are primarily intended to remove a small amount of material, in many cases, like hand reaming, a Carbon Steel Reamer may be preferable to a Reamer made from High Speed Steel. On production jobs a High Speed Steel Reamer may be more desirable.

All our Reamers are made to our standard commercial limits of accuracy. We are prepared to make Reamers to much closer limits. In the field of special Reamers we are prepared to make Reamers of various types for different operations. If we know for what purpose a Reamer is to be used we will furnish sketches and other information when necessary.

All Reamers, stock or special, are made with the intention that they shall be the best in their respective classes. Our experience and reputation for producing tools of quality is our guarantee.

Stub Screw Machine Reamers

HIGH SPEED STEEL NO. 906



Stub Reamers are free cutting production tools, economical to use as their short length practically eliminates breakage.

Stub Reamers are particularly desirable on production jobs where close tolerances must be maintained without lost time in gauging small parts, sharpening tools and making machine adjustments.

These reamers are regularly furnished with right hand cut and left hand spiral flutes.

Left hand reamers and reamers with right hand spiral flutes are special.

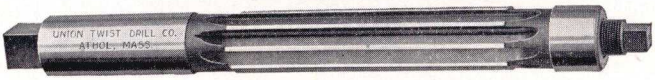
Sizes and dimensions not listed are special.

SIZES AND DIMENSIONS

Series Number	A (Range) Inches	B Inches	C Inches	D Inches	E Inches	H Inches
00	.0600 to .066 Incl.	1 3/4	1/2	1/8	1	1/16
0	.0661 to .074 Incl.	1 3/4	1/2	1/8	1	1/16
1	.0741 to .084 Incl.	1 3/4	1/2	1/8	1	1/16
2	.0841 to .096 Incl.	1 3/4	1/2	1/8	1	1/16
3	.0961 to .126 Incl.	2	3/4	1/8	1	1/16
4	.1261 to .158 Incl.	2 1/4	1	1/4	1	3/32
5	.1581 to .188 Incl.	2 1/4	1	1/4	1	3/32
6	.1881 to .219 Incl.	2 1/4	1	1/4	1	3/32
7	.2191 to .251 Incl.	2 1/4	1	1/4	1	3/32
8	.2511 to .282 Incl.	2 1/4	1	3/8	1	1/8
9	.2821 to .313 Incl.	2 1/4	1	3/8	1	1/8
10	.3131 to .344 Incl.	2 1/2	1 1/4	3/8	1	1/8
11	.3441 to .376 Incl.	2 1/2	1 1/4	3/8	1	1/8
12	.3761 to .407 Incl.	2 1/2	1 1/4	1/2	1	3/16
13	.4071 to .439 Incl.	2 1/2	1 1/4	1/2	1	3/16
14	.4391 to .470 Incl.	2 1/2	1 1/4	1/2	1	3/16
15	.4701 to .505 Incl.	2 1/2	1 1/4	1/2	1	3/16
16	.5051 to .567 Incl.	3	1 1/2	5/8	1 1/4	1/4
17	.5671 to .630 Incl.	3	1 1/2	5/8	1 1/4	1/4
18	.6301 to .692 Incl.	3	1 1/2	5/8	1 1/4	1/4
19	.6921 to .755 Incl.	3	1 1/2	3/4	1 1/4	5/16
20	.7551 to .817 Incl.	3	1 1/2	3/4	1 1/4	5/16
21	.8171 to .880 Incl.	3	1 1/2	3/4	1 1/4	5/16
22	.8801 to .942 Incl.	3	1 1/2	3/4	1 1/4	5/16
23	.9421 to 1.010 Incl.	3	1 1/2	3/4	1 1/4	5/16

Prices on application.

Expansion Hand Reamers



Expansion Hand Reamers are particularly designed for work where it is necessary to enlarge reamed holes by a few thousandths.

The recommended limits of expansion are as follows:—

1/4″ to 15/32″ inclusive, .005 inch
1/2″ to 31/32″ inclusive, .008 inch
1″ to 1 11/16″ inclusive, .010 inch
1 3/4″ to 2″ inclusive, .012 inch

The guides to these Reamers are ground .005 inch undersize.

CARBON STEEL

No. 828 STRAIGHT FLUTES **No. 838 SPIRAL FLUTES**

Diameter Inches	Price Each		Whole Length Inches	Length of Flutes Inches
	Straight Flute	Spiral Flute		
1/4	$3.00	$3.60	4	1 1/2
9/32	3.10		4	1 1/2
5/16	3.10	3.70	4	1 1/2
11/32	3.20		4	1 1/2
3/8	3.20	3.85	5	2
13/32	3.30		5	2
7/16	3.30	4.00	5	2
15/32	3.40		5	2
1/2	3.40	4.10	6	2 1/2
17/32	3.65		6	2 1/2
9/16	3.65	4.40	6	2 1/2
19/32	4.00		6	2 1/2
5/8	4.00	4.80	7	3
21/32	4.40		7	3
11/16	4.40	5.30	7	3
23/32	4.80		7	3
3/4	4.80	5.80	8	3 1/2

List continued on page 239

Expansion Hand Reamers—continued

CARBON STEEL

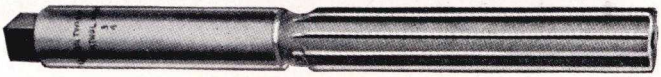
No. 828 STRAIGHT FLUTES **No. 838 SPIRAL FLUTES**

Diameter Inches	Price Each		Whole Length Inches	Length of Flutes Inches
	Straight Flute	Spiral Flute		
25/32	$ 5.25		8	3½
13/16	5.25	$ 6.30	8	3½
27/32	5.75		8	3½
7/8	5.75	6.90	9	4
29/32	6.25		9	4
15/16	6.25	7.50	9	4
31/32	6.75		9	4
1″	6.75	8.10	10	4½
1 1/32	7.25		10	4½
1 1/16	7.25	8.70	10	4½
1 3/32	7.75		10	4½
1 1/8	7.75	9.30	10½	4¾
1 5/32	8.30		10½	4¾
1 3/16	8.30	10.00	10½	4¾
1 7/32	8.90		10½	4¾
1 1/4	8.90	10.70	11	5
1 9/32	9.50		11	5
1 5/16	9.50	11.40	11	5
1 11/32	10.50		11	5
1 3/8	10.50	12.60	11½	5¼
1 13/32	11.50		11½	5¼
1 7/16	11.50	13.80	11½	5¼
1 15/32	12.50		11½	5¼
1 1/2	12.50	15.00	12	5½
1 9/16	13.00	15.60	12	5½
1 5/8	13.50	16.20	12½	5¾
1 11/16	14.00	16.80	12½	5¾
1 3/4	14.50	17.40	13	6
1 13/16	15.00	18.00	13	6
1 7/8	15.50	18.60	13½	6¼
1 15/16	16.00	19.20	13½	6¼
2″	16.50	19.80	14	6½

Limits of expansion recommended for these Reamers see page 238.

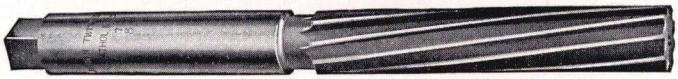
Hand Reamers

Flutes are slightly tapered on end and cleared to edge.



STRAIGHT FLUTES

CARBON STEEL No. 800 **HIGH SPEED STEEL No. 900**



SPIRAL FLUTES

CARBON STEEL No. 801 **HIGH SPEED STEEL No. 901**

Diameter Inches	Price Each Carbon Steel		Price Each High Speed Steel		Whole Length Inches	Length of Flutes Inches
	Straight Flute	Spiral Flute	Straight Flute	Spiral Flute		
1/8	$1.00	$1.20	$3.00		3	1 1/2
9/64	1.20				3 1/4	1 5/8
5/32	1.20	1.45	3.25		3 1/4	1 5/8
11/64	1.20				3 1/2	1 3/4
3/16	1.20	1.45	3.25		3 1/2	1 3/4
13/64	1.40				3 3/4	1 7/8
7/32	1.40	1.70	3.50		3 3/4	1 7/8
15/64	1.40				4	2
1/4	1.40	1.70	3.50	$3.85	4	2
17/64	1.50				4 1/4	2 1/8
9/32	1.50	1.80	3.75	4.15	4 1/4	2 1/8
19/64	1.50				4 1/2	2 1/4
5/16	1.50	1.80	3.75	4.15	4 1/2	2 1/4
21/64	1.60				4 3/4	2 3/8
11/32	1.60	1.90	4.25	4.70	4 3/4	2 3/8
23/64	1.60				5	2 1/2
3/8	1.60	1.90	4.25	4.70	5	2 1/2

For sets of Straight Flute Hand Reamers see page 264.

List continued on page 241

Hand Reamers—continued

STRAIGHT FLUTES

CARBON STEEL No. 800 **HIGH SPEED STEEL No. 900**

SPIRAL FLUTES

CARBON STEEL No. 801 **HIGH SPEED STEEL No. 901**

Diameter Inches	Price Each Carbon Steel		Price Each High Speed Steel		Whole Length Inches	Length of Flutes Inches
	Straight Flute	Spiral Flute	Straight Flute	Spiral Flute		
25/64	$1.75				5 1/4	2 5/8
13/32	1.75	$2.10	$4.75	$5.25	5 1/4	2 5/8
27/64	1.75				5 1/2	2 3/4
7/16	1.75	2.10	4.75	5.25	5 1/2	2 3/4
29/64	1.90				5 3/4	2 7/8
15/32	1.90	2.30	5.25	5.80	5 3/4	2 7/8
31/64	1.90				6	3
1/2	1.90	2.30	5.25	5.80	6	3
33/64	2.00				6 1/4	3 1/8
17/32	2.00	2.40	5.75	6.35	6 1/4	3 1/8
35/64	2.00				6 1/2	3 1/4
9/16	2.00	2.40	5.75	6.35	6 1/2	3 1/4
37/64	2.20				6 3/4	3 3/8
19/32	2.20	2.65	6.25	6.90	6 3/4	3 3/8
39/64	2.20				7	3 1/2
5/8	2.20	2.65	6.25	6.90	7	3 1/2
41/64	2.40				7 3/8	3 11/16
21/32	2.40	2.90	6.75	7.45	7 3/8	3 11/16
43/64	2.40				7 3/4	3 7/8
11/16	2.40	2.90	6.75	7.45	7 3/4	3 7/8
45/64	2.60				8 1/8	4 1/16
23/32	2.60	3.10	7.25	8.00	8 1/8	4 1/16
47/64	2.60				8 3/8	4 3/16
3/4	2.60	3.10	7.25	8.00	8 3/8	4 3/16

For sets of Straight Flute Hand Reamers see page 264.

List continued on page 242

Hand Reamers—continued

STRAIGHT FLUTES

CARBON STEEL No. 800 **HIGH SPEED STEEL No. 900**

SPIRAL FLUTES

CARBON STEEL No. 801 **HIGH SPEED STEEL No. 901**

Diameter Inches	Price Each Carbon Steel		Price Each High Speed Steel		Whole Length Inches	Length of Flutes Inches
	Straight Flute	Spiral Flute	Straight Flute	Spiral Flute		
25/32	$2.80	$3.35	$ 7.75	$ 8.55	8 3/4	4 3/8
13/16	2.80	3.35	7.75	8.55	9 1/8	4 9/16
27/32	3.10	3.70	8.50	9.35	9 3/8	4 11/16
7/8	3.10	3.70	8.50	9.35	9 3/4	4 7/8
29/32	3.40	4.10	9.50	10.45	10	5
15/16	3.40	4.10	9.50	10.45	10 1/4	5 1/8
31/32	3.70	4.45	10.50	11.55	10 5/8	5 5/16
1″	3.70	4.45	10.50	11.55	10 7/8	5 7/16
1 1/16	4.00	4.80	11.50	12.65	11 1/4	5 5/8
1 1/8	4.30	5.15	12.75	14.00	11 5/8	5 13/16
1 3/16	4.60	5.50	14.25	15.70	12	6
1 1/4	4.90	5.90	15.75	17.35	12 1/4	6 1/8
1 5/16	5.20	6.25	17.25	19.00	12 1/2	6 1/4
1 3/8	5.60	6.70	18.75	20.65	12 5/8	6 5/16
1 7/16	6.00	7.20	20.50	22.55	12 7/8	6 7/16
1 1/2	6.40	7.70	22.25	24.50	13	6 1/2
1 9/16	6.80				13	6 1/2
1 5/8	7.20				13	6 1/2
1 11/16	7.60				13 1/2	6 3/4
1 3/4	8.00				13 1/2	6 3/4
1 13/16	8.40				13 1/2	6 3/4
1 7/8	8.80				14	7
1 15/16	9.20				14	7
2″	9.60				14	7

For sets of Straight Flute Hand Reamers see page 264.

Jobbers' Reamers

TAPER SHANKS

Jobbers' Reamers with taper shanks are the same design as Hand Reamers except that the shanks are tapered for machine use. Flutes are slightly tapered on end and cleared to edge.

STRAIGHT FLUTES

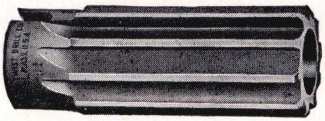
CARBON STEEL No. 808 **HIGH SPEED STEEL No. 908**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
1/4	$1.70	$ 4.00	5 3/16	2	
9/32		4.25	5 3/16	2	
5/16	1.80	4.25	5 1/2	2 1/4	
11/32		4.75	5 1/2	2 1/4	
3/8	1.90	4.75	5 13/16	2 1/2	
13/32		5.25	5 13/16	2 1/2	No. 1
7/16	2.15	5.25	6 1/8	2 3/4	
15/32		5.75	6 1/8	2 3/4	
1/2	2.30	5.75	6 7/16	3	
17/32		6.25	6 7/16	3	
9/16	2.40	6.25	6 3/4	3 1/4	
19/32		6.75	6 3/4	3 1/4	
5/8	2.65	6.75	7 9/16	3 1/2	
21/32		7.25	7 9/16	3 1/2	
11/16	2.90	7.25	8	3 7/8	
23/32		7.75	8	3 7/8	No. 2
3/4	3.10	7.75	8 3/8	4 3/16	
13/16	3.35	8.50	8 13/16	4 9/16	
7/8	3.70	9.50	9 3/16	4 7/8	
15/16	4.10	10.50	10	5 1/8	
1″	4.45	11.50	10 3/8	5 7/16	
1 1/16	4.80	12.50	10 5/8	5 5/8	No. 3
1 1/8	5.15	13.75	10 7/8	5 13/16	
1 3/16	5.50	15.25	11 1/8	6	
1 1/4	5.90	16.75	12 9/16	6 1/8	
1 5/16	6.25	18.25	12 11/16	6 1/4	
1 3/8	6.70	19.75	12 13/16	6 5/16	No. 4
1 7/16	7.20	21.50	13	6 7/16	
1 1/2	7.70	23.25	13 1/8	6 1/2	

Spiral Flute Taper Shank Jobbers' Reamers are special. Prices on application.

For Sockets and Sleeves see pages 274–275.

Fluted Shell Reamers



Fluted Shell Reamers are designed as a sizing or finishing reamer and are held on an arbor provided with driving lugs. Flutes are cleared to edge.

The holes in these reamers are tapered, 1/8 inch per foot.

STRAIGHT FLUTES

CARBON STEEL No. 810 **HIGH SPEED STEEL No. 910**

SPIRAL FLUTES

CARBON STEEL No. 811 **HIGH SPEED STEEL No. 911**

Diameter Inches	Price Each Carbon Steel		Price Each High Speed Steel		Whole Length Inches	Diameter Hole Large End Inches	Fitting Arbor No.
	Straight Flute	Spiral Flute	Straight Flute	Spiral Flute			
3/4	$2.10	$2.50	$3.85	$4.25	2 1/4	3/8	4
13/16	2.20	2.65	4.00	4.40	2 1/2	1/2	5
7/8	2.30	2.75	4.25	4.70	2 1/2	1/2	5
15/16	2.40	2.90	4.50	4.95	2 1/2	1/2	5
1"	2.50	3.00	4.75	5.25	2 1/2	1/2	5
1 1/16	2.70	3.25	5.00	5.50	2 3/4	5/8	6
1 1/8	2.90	3.50	5.25	5.80	2 3/4	5/8	6
1 3/16	3.10	3.70	5.50	6.05	2 3/4	5/8	6
1 1/4	3.30	3.95	5.75	6.35	2 3/4	5/8	6
1 5/16	3.55	4.25	6.00	6.60	3	3/4	7
1 3/8	3.80	4.55	6.50	7.15	3	3/4	7
1 7/16	4.05	4.85	7.00	7.70	3	3/4	7
1 1/2	4.30	5.15	7.50	8.25	3	3/4	7
1 9/16	4.55	5.45	8.25	9.10	3	3/4	7
1 5/8	4.80	5.75	9.00	9.90	3	3/4	7

Carbon Steel and High Speed Steel Rose Shell Reamers can be furnished. Prices on application.

For Shell Reamer Arbors, see page 270.

List continued on page 245

Fluted Shell Reamers—continued

STRAIGHT FLUTES

CARBON STEEL No. 810 **HIGH SPEED STEEL No. 910**

SPIRAL FLUTES

CARBON STEEL No. 811 **HIGH SPEED STEEL No. 911**

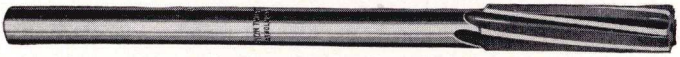
Diameter Inches	Price Each Carbon Steel		Price Each High Speed Steel		Whole Length Inches	Diameter Hole Large End Inches	Fitting Arbor No.
	Straight Flute	Spiral Flute	Straight Flute	Spiral Flute			
1 11/16	$ 5.10	$6.10	$9.75	$10.75	3 1/2	1	8
1 3/4	5.40	6.50	10 50	11.55	3 1/2	1	8
1 13/16	5.70	6.85	11.25	12.40	3 1/2	1	8
1 7/8	6.00	7.20	12.00	13.20	3 1/2	1	8
1 15/16	6.30	7.55	12.75	14.05	3 1/2	1	8
2"	6.60	7.90	13.50	14.85	3 1/2	1	8
2 1/16	6.95		14.25	15.70	3 3/4	1 1/4	9
2 1/8	7.30		15.00	16.50	3 3/4	1 1/4	9
2 3/16	7.65		15.75	17.35	3 3/4	1 1/4	9
2 1/4	8.00		16.50	18.15	3 3/4	1 1/4	9
2 5/16	8.35		17.25	19.00	3 3/4	1 1/4	9
2 3/8	8.70		18.00	19.80	3 3/4	1 1/4	9
2 7/16	9.05		18.75	20.65	3 3/4	1 1/4	9
2 1/2	9.40		19.50	21.45	3 3/4	1 1/4	9
2 9/16	9.80		20.50	22.55	4	1 1/2	10
2 5/8	10.20		21.75	23.95	4	1 1/2	10
2 11/16	10.60		23.00	25.30	4	1 1/2	10
2 3/4	11.00		24.25	26.70	4	1 1/2	10
2 13/16	11.40		25.50	28.05	4	1 1/2	10
2 7/8	11.80		27.00	29.70	4	1 1/2	10
2 15/16	12.20		28.50	31.35	4	1 1/2	10
3"	12.60		30.00	33.00	4	1 1/2	10

Carbon Steel and High Speed Steel Rose Shell Reamers can be furnished. Prices on application.

For Shell Reamer Arbors, see page 270.

Fluted Chucking Reamers

SPIRAL FLUTES



STRAIGHT SHANK—SPIRAL FLUTES

TAPER SHANK—SPIRAL FLUTES

Fluted Chucking Reamers are designed for use in turret lathes, screw machines, etc.

These reamers have a slight chamfer of 45° on the end and flutes are cleared to edge but not tapered.

HIGH SPEED STEEL—STRAIGHT SHANK No. 960
HIGH SPEED STEEL—TAPER SHANK No. 965

Diameter Inches	Price Each High Speed Steel		Whole Length Inches	Length of Flutes Inches	Diameter Straight Shank Inches	Morse Taper Shank
	Straight Shank	Taper Shank				
1/8	$2.20		3 1/2	7/8	7/64	
5/32	2.75		4	1	9/64	
3/16	2.75		4 1/2	1 1/8	11/64	
7/32	3.30		5	1 1/4	13/64	
1/4	3.30	$3.85	6	1 1/2	15/64	
9/32	3.60	4.15	6	1 1/2	15/64	
5/16	3.60	4.15	6	1 1/2	9/32	
11/32	4.15	4.70	6	1 1/2	9/32	No. 1
3/8	4.15	4.70	7	1 3/4	5/16	
13/32	4.70	5.25	7	1 3/4	5/16	
7/16	4.70	5.25	7	1 3/4	3/8	
15/32	5.25	5.80	7	1 3/4	3/8	

For Fluted Chucking Reamers with straight flutes see pages 248–250.

For Sockets and Sleeves see pages 274–275.

List continued on page 247

Fluted Chucking Reamers

SPIRAL FLUTES

HIGH SPEED STEEL—STRAIGHT SHANK No. 960

HIGH SPEED STEEL—TAPER SHANK No. 965

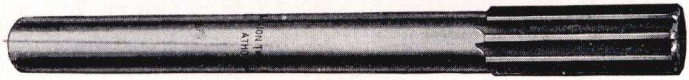
Diameter Inches	Price Each High Speed Steel		Whole Length Inches	Length of Flutes Inches	Diameter Straight Shank Inches	Morse Taper Shank
	Straight Shank	Taper Shank				
1/2	$ 5.25	$ 5.80	8	2	7/16	No. 1
17/32	5.80	6.35	8	2	7/16	
9/16	5.80	6.35	8	2	7/16	
19/32	6.35	6.90	8	2	7/16	
5/8	6.35	6.90	9	2 1/4	9/16	No. 2
21/32	6.90	7.45	9	2 1/4	9/16	
11/16	6.90	7.45	9	2 1/4	9/16	
23/32	7.45	8.00	9	2 1/4	9/16	
3/4	7.45	8.00	9 1/2	2 1/2	5/8	
25/32	8.00	8.80	9 1/2	2 1/2	5/8	
13/16	8.00	8.80	9 1/2	2 1/2	5/8	
27/32	8.80	9.90	9 1/2	2 1/2	5/8	
7/8	8.80	9.90	10	2 5/8	3/4	
29/32	9.90	11.00	10	2 5/8	3/4	
15/16	9.90	11.00	10	2 5/8	3/4	No. 3
31/32	11.00	12.10	10	2 5/8	3/4	
1	11.00	12.10	10 1/2	2 3/4	7/8	
1 1/16	12.40	13.50	10 1/2	2 3/4	7/8	
1 1/8	13.75	14.85	11	2 7/8	7/8	
1 3/16	15.15	16.25	11	2 7/8	1	
1 1/4	16.80	17.90	11 1/2	3	1	No. 4
1 5/16	18.70	19.80	11 1/2	3	1	
1 3/8	20.65	21.75	12	3 1/4	1	
1 7/16	22.55	23.65	12	3 1/4	1 1/4	
1 1/2	24.50	25.60	12 1/2	3 1/2	1 1/4	

For Fluted Chucking Reamers with straight flutes see pages 248–250.

For Sockets and Sleeves see pages 274–275.

Fluted Chucking Reamers

STRAIGHT SHANKS—STRAIGHT FLUTES



Fluted Chucking Reamers are designed for use in turret lathes, screw machines, etc.

These reamers have a slight chamfer of 45° on the end and flutes are cleared to edge but not tapered.

CARBON STEEL No. 850 **HIGH SPEED STEEL No. 950**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches
1/8	$ .90	$2.00	3 1/2	7/8
5/32	1.00	2.50	4	1
3/16	1.00	2.50	4 1/2	1 1/8
7/32	1.20	3.00	5	1 1/4
1/4	1.20	3.00	6	1 1/2
9/32	1.30	3.25	6	1 1/2
5/16	1.30	3.25	6	1 1/2
11/32	1.45	3.75	6	1 1/2
3/8	1.45	3.75	7	1 3/4
13/32	1.60	4.25	7	1 3/4
7/16	1.60	4.25	7	1 3/4
15/32	1.80	4.75	7	1 3/4
1/2	1.80	4.75	8	2
17/32	2.00	5.25	8	2
9/16	2.00	5.25	8	2

For Straight Shank Fluted Chucking Reamers with spiral flutes see pages 246–247.

List continued on page 249

Fluted Chucking Reamers—continued

STRAIGHT SHANKS—STRAIGHT FLUTES

CARBON STEEL No. 850 **HIGH SPEED STEEL No. 950**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches
19/32	$2.25	$ 5.75	8	2
5/8	2.25	5.75	9	2 1/4
21/32	2.40	6.25	9	2 1/4
11/16	2.40	6.25	9	2 1/4
23/32	2.55	6.75	9	2 1/4
3/4	2.55	6.75	9 1/2	2 1/2
25/32	2.80	7.25	9 1/2	2 1/2
13/16	2.80	7.25	9 1/2	2 1/2
27/32	3.00	8.00	9 1/2	2 1/2
7/8	3.00	8.00	10	2 5/8
29/32	3.25	9.00	10	2 5/8
15/16	3.25	9.00	10	2 5/8
31/32	3.45	10.00	10	2 5/8
1″	3.45	10.00	10 1/2	2 3/4
1 1/16	3.70	11.25	10 1/2	2 3/4
1 1/8	3.90	12.50	11	2 7/8
1 3/16	4.15	13.75	11	2 7/8
1 1/4	4.35	15.25	11 1/2	3
1 5/16	4.60	17.00	11 1/2	3
1 3/8	4.80	18.75	12	3 1/4
1 7/16	5.05	20.50	12	3 1/4
1 1/2	5.25	22.25	12 1/2	3 1/2

For Straight Shank Fluted Chucking Reamers with spiral flutes see pages 246–247.

Fluted Chucking Reamers

TAPER SHANKS—STRAIGHT FLUTES

Fluted Chucking Reamers are designed for use in turret lathes, screw machines, etc.

These reamers have a slight chamfer of 45° on the end and flutes are cleared to edge but not tapered.

CARBON STEEL No. 855 **HIGH SPEED STEEL No. 955**

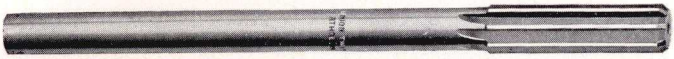
Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
1/4	$1.45	$ 3.50	6	1 1/2	
9/32	1.55	3.75	6	1 1/2	
5/16	1.55	3.75	6	1 1/2	
11/32	1.75	4.25	6	1 1/2	
3/8	1.75	4.25	7	1 3/4	
13/32	1.90	4.75	7	1 3/4	No. 1
7/16	1.90	4.75	7	1 3/4	
15/32	2.15	5.25	7	1 3/4	
1/2	2.15	5.25	8	2	
17/32	2.40	5.75	8	2	
9/16	2.40	5.75	8	2	
19/32	2.70	6.25	8	2	
5/8	2.70	6.25	9	2 1/4	
21/32	2.90	6.75	9	2 1/4	
11/16	2.90	6.75	9	2 1/4	
23/32	3.05	7.25	9	2 1/4	
3/4	3.05	7.25	9 1/2	2 1/2	No. 2
25/32	3.35	8.00	9 1/2	2 1/2	
13/16	3.35	8.00	9 1/2	2 1/2	
27/32	3.60	9.00	9 1/2	2 1/2	
7/8	3.60	9.00	10	2 5/8	
29/32	3.90	10.00	10	2 5/8	
15/16	3.90	10.00	10	2 5/8	
31/32	4.15	11.00	10	2 5/8	
1"	4.15	11.00	10 1/2	2 3/4	No. 3
1 1/16	4.45	12.25	10 1/2	2 3/4	
1 1/8	4.70	13.50	11	2 7/8	
1 3/16	5.00	14.75	11	2 7/8	
1 1/4	5.20	16.25	11 1/2	3	
1 5/16	5.50	18.00	11 1/2	3	
1 3/8	5.75	19.75	12	3 1/4	No. 4
1 7/16	6.05	21.50	12	3 1/4	
1 1/2	6.30	23.25	12 1/2	3 1/2	

For Taper Shank Fluted Chucking Reamers with spiral flutes see pages 246–247.

For Sockets and Sleeves see pages 274–275.

Rose Chucking Reamers

STRAIGHT SHANKS



Rose Chucking Reamers are designed to cut only on the end and are particularly adapted for reaming cored holes.

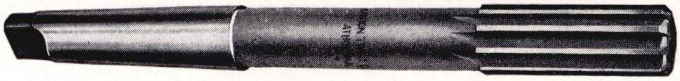
Flutes are ground cylindrical and cleared on chamfer only.

CARBON STEEL No. 851 **HIGH SPEED STEEL No. 951**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches
1/8	$ .90	$ 2.00	3 1/2	7/8
5/32	1.00	2.50	4	1
3/16	1.00	2.50	4 1/2	1 1/8
7/32	1.20	3.00	5	1 1/4
1/4	1.20	3.00	6	1 1/2
9/32	1.30	3.25	6	1 1/2
5/16	1.30	3.25	6	1 1/2
11/32	1.45	3.75	6	1 1/2
3/8	1.45	3.75	7	1 3/4
13/32	1.60	4.25	7	1 3/4
7/16	1.60	4.25	7	1 3/4
15/32	1.80	4.75	7	1 3/4
1/2	1.80	4.75	8	2
9/16	2.00	5.25	8	2
5/8	2.25	5.75	9	2 1/4
11/16	2.40	6.25	9	2 1/4
3/4	2.55	6.75	9 1/2	2 1/2
13/16	2.80	7.25	9 1/2	2 1/2
7/8	3.00	8.00	10	2 5/8
15/16	3.25	9.00	10	2 5/8
1"	3.45	10.00	10 1/2	2 3/4
1 1/8	3.90	12.50	11	2 7/8
1 1/4	4.35	15.25	11 1/2	3
1 3/8	4.80	18.75	12	3 1/4
1 1/2	5.25	22.25	12 1/2	3 1/2

Rose Chucking Reamers

TAPER SHANKS



Rose Chucking Reamers are designed to cut only on the end and are particularly adapted for reaming cored holes.

Flutes are ground cylindrical and cleared on chamfer only.

CARBON STEEL No. 856 **HIGH SPEED STEEL No. 956**

Diameter Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
1/4	$1.45	$ 3.50	6	1 1/2	No. 1
9/32	1.55	3.75	6	1 1/2	
5/16	1.55	3.75	6	1 1/2	
11/32	1.75	4.25	6	1 1/2	
3/8	1.75	4.25	7	1 3/4	
13/32	1.90	4.75	7	1 3/4	
7/16	1.90	4.75	7	1 3/4	
15/32	2.15	5.25	7	1 3/4	
1/2	2.15	5.25	8	2	
9/16	2.40	5.75	8	2	
5/8	2.70	6.25	9	2 1/4	No. 2
11/16	2.90	6.75	9	2 1/4	
3/4	3.05	7.25	9 1/2	2 1/2	
13/16	3.35	8.00	9 1/2	2 1/2	
7/8	3.60	9.00	10	2 5/8	
15/16	3.90	10.00	10	2 5/8	No. 3
1"	4.15	11.00	10 1/2	2 3/4	
1 1/16		12.25	10 1/2	2 3/4	
1 1/8	4.70	13.50	11	2 7/8	
1 3/16		14.75	11	2 7/8	
1 1/4	5.20	16.25	11 1/2	3	No. 4
1 5/16		18.00	11 1/2	3	
1 3/8	5.75	19.75	12	3 1/4	
1 7/16		21.50	12	3 1/4	
1 1/2	6.30	23.25	12 1/2	3 1/2	

For Sockets and Sleeves see pages 274–275.

Taper Pin Reamers

WITH STRAIGHT FLUTES

WITH SQUARE SHANKS

Taper ¼ inch per foot

Point of each reamer will enter hole reamed by next smaller size.

CARBON STEEL No. 845 **HIGH SPEED STEEL No. 945**

Size No.	Price Each Carbon Steel	Price Each High Speed Steel	Diameter of Shank	Diameter of Small End	Diameter of Large End	Whole Length Inches	Length of Flutes Inches
7/0	$1.75	$3.50	5/64	.0497	.0666	1 13/16	13/16
6/0	1.60	3.50	3/32	.0611	.0806	1 15/16	15/16
5/0	1.50	3.25	7/64	.0719	.0966	2 3/16	1 3/16
4/0	1.50	3.25	1/8	.0869	.1142	2 5/16	1 5/16
3/0	1.50	3.25	9/64	.1029	.1302	2 5/16	1 5/16
2/0	1.35	3.00	5/32	.1137	.1462	2 9/16	1 9/16
0	1.00	2.80	11/64	.1287	.1638	2 15/16	1 11/16
1	1.00	2.90	3/16	.1447	.1798	2 15/16	1 11/16
2	1.25	3.00	13/64	.1605	.2008	3 3/16	1 15/16
3	1.50	3.00	15/64	.1813	.2294	3 11/16	2 5/16
4	1.75	3.25	17/64	.2071	.2604	4 1/16	2 9/16
5	2.00	3.50	5/16	.2409	.2994	4 5/16	2 13/16
6	2.25	4.25	23/64	.2773	.354	5 7/16	3 11/16
7	2.50	5.25	13/32	.3297	.422	6 5/16	4 7/16
8	3.00	6.75	7/16	.3971	.505	7 3/16	5 3/16
9	3.50	8.25	9/16	.4805	.6066	8 5/16	6 1/16
10	4.50	9.00	5/8	.5799	.7216	9 5/16	6 13/16

For sets of Straight Flute Taper Pin Reamers see page 264.

Taper Pin Reamers

WITH SPIRAL FLUTES

WITH SQUARE SHANKS

Taper ¼ inch per foot

Point of each reamer will enter hole reamed by next smaller size.

CARBON STEEL No. 847 **HIGH SPEED STEEL No. 947**

Size No.	Price Each Carbon Steel	Price Each High Speed Steel	Diameter of Shank	Diameter of Small End	Diameter of Large End	Whole Length Inches	Length of Flutes Inches
7/0	$2.10	$3.85	5/64	.0497	.0666	1 13/16	13/16
6/0	1.95	3.85	3/32	.0611	.0806	1 15/16	15/16
5/0	1.80	3.60	7/64	.0719	.0966	2 3/16	1 3/16
4/0	1.80	3.60	1/8	.0869	.1142	2 5/16	1 5/16
3/0	1.80	3.60	9/64	.1029	.1302	2 5/16	1 5/16
2/0	1.65	3.30	5/32	.1137	.1462	2 9/16	1 9/16
0	1.20	3.10	11/64	.1287	.1638	2 15/16	1 11/16
1	1.20	3.20	3/16	.1447	.1798	2 15/16	1 11/16
2	1.50	3.30	13/64	.1605	.2008	3 3/16	1 15/16
3	1.80	3.30	15/64	.1813	.2294	3 11/16	2 5/16
4	2.10	3.60	17/64	.2071	.2604	4 1/16	2 9/16
5	2.40	3.85	5/16	.2409	.2994	4 5/16	2 13/16
6	2.70	4.70	23/64	.2773	.354	5 7/16	3 11/16
7	3.00	5.80	13/32	.3297	.422	6 5/16	4 7/16
8	3.60	7.45	7/16	.3971	.505	7 3/16	5 3/16
9	4.20	9.10	9/16	.4805	.6066	8 5/16	6 1/16
10	5.40	9.90	5/8	.5799	.7216	9 5/16	6 13/16

Taper Pin Reamers

WITH HELICAL FLUTES

Taper 1/4 inch per foot

The helical construction of these reamers has a tendency to prevent chips from clogging in the flutes, reducing breakage to a minimum.

Point of each reamer will enter hole reamed by next smaller size.

CARBON STEEL No. 857 **HIGH SPEED STEEL No. 957**

Size No.	Price Each Carbon Steel	Price Each High Speed Steel	Diameter of Shank	Diameter of Small End	Diameter of Large End	Whole Length Inches	Length of Flutes Inches
7/0	$2.25	$2.75	5/64	.0497	.0666	1 13/16	13/16
6/0	2.00	2.50	3/32	.0611	.0806	1 15/16	15/16
5/0	2.00	2.50	7/64	.0719	.0966	2 3/16	1 3/16
4/0	2.00	2.50	1/8	.0869	.1142	2 5/16	1 5/16
3/0	1.75	2.25	9/64	.1029	.1302	2 5/16	1 5/16
2/0	1.75	2.25	5/32	.1137	.1462	2 9/16	1 9/16
0	1.75	2.25	11/64	.1287	.1638	2 15/16	1 11/16
1	2.00	2.50	3/16	.1447	.1798	2 15/16	1 11/16
2	2.25	2.75	13/64	.1605	.2008	3 3/16	1 15/16
3	2.50	3.00	15/64	.1813	.2294	3 11/16	2 5/16
4	2.75	3.50	17/64	.2071	.2604	4 1/16	2 9/16
5	3.00	3.75	5/16	.2409	.2994	4 5/16	2 13/16
6	3.50	4.25	23/64	.2773	.354	5 7/16	3 11/16
7	4.00	5.00	13/32	.3297	.422	6 5/16	4 7/16
8	4.50	5.75	7/16	.3971	.505	7 3/16	5 3/16
9	5.00	6.25	9/16	.4805	.6066	8 5/16	6 1/16
10	6.00	7.50	5/8	.5799	.7216	9 5/16	6 13/16

Taper Reamer

BROWN & SHARPE STANDARD

FINISHING REAMER

These reamers are designed for reaming Brown & Sharpe standard tapers.

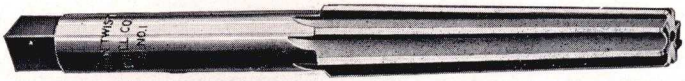
CARBON STEEL No. 835

No. of Taper	Price Each	Whole Length Inches	Length of Flutes Inches	Size of Finishing Reamer	
				Large End	Small End
1	$1.75	4 3/4	2 7/8	.320	.200
2	2.00	5 1/8	3 1/8	.380	.250
3	2.25	5 1/2	3 3/8	.453	.312
4	2.50	5 7/8	3 11/16	.504	.350
5	3.00	6 3/8	4	.617	.450
6	3.25	6 7/8	4 3/8	.682	.500
7	3.50	7 1/2	4 7/8	.803	.600
8	3.75	8 1/8	5 1/2	.979	.750
9	4.00	8 7/8	6 1/8	1.155	.900
10	5.00	9 3/4	6 7/8	1.340	1.045
11	6.00	10 5/8	7 5/8	1.568	1.250
12	8.00	11 3/8	8 1/4	1.844	1.500

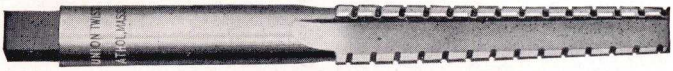
Roughing Reamers can be furnished at special prices.

Prices on application.

Morse Taper Reamers



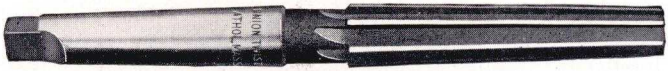
FINISHING REAMER
CARBON STEEL No. 825



ROUGHING REAMER
CARBON STEEL No. 820

No. of Taper	Price Each		Whole Length Inches	Length of Flutes Inches	Size of Finishing Reamer	
	Finishing	Roughing			Large End	Small End
0	$1.60	$1.90	3¾	2¼	.367	.250
1	2.00	2.40	5	3	.517	.367
2	2.60	3.10	6	3½	.745	.569
3	3.40	4.10	7¼	4¼	.988	.775
4	4.20	5.05	8½	5¼	1.289	1.017
5	6.60	7.90	9¾	6¼	1.799	1.471
6	12.00	14.40	12¼	8½	2.555	2.112

WITH TAPER SHANKS



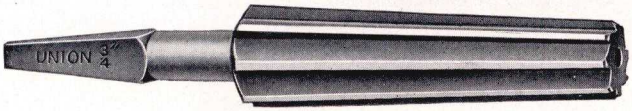
FINISHING REAMER
CARBON STEEL No. 826

ROUGHING REAMER
CARBON STEEL No. 821

No. of Taper	Price Each		Whole Length Inches	Length of Flutes Inches	Size of Finishing Reamer		Morse Taper Shank No.
	Finishing	Roughing			Large End	Small End	
0	$2.65	$3.20	5 11/32	2¼	.367	.250	0
1	2.95	3.55	6 5/16	3	.517	.367	1
2	3.25	3.90	7 3/8	3½	.745	.569	2
3	4.45	5.35	8 7/8	4¼	.988	.775	3
4	6.00	7.20	10 7/8	5¼	1.289	1.017	4
5	10.10	12.10	13 1/8	6¼	1.799	1.471	5
6	21.35	25.60	17 13/16	8½	2.555	2.112	6

For sets of Straight Shank Morse Taper Finishing Reamers see page 264.

Bit Stock Taper Reamers



All sizes have Standard Taper Square Shank. 3/16″ x 3/8″ x 1 1/4″ long.

Diameter at larger end of flutes is 1/16 inch larger than nominal size. Taper 1 inch per foot.

CARBON STEEL No. 840

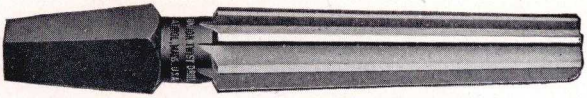
Nominal Size Inches	Price Each	Whole Length Inches	Length of Flutes Inches	Diameter Small End Inches	Diameter Large End Inches
1/8	$0.60	3 3/4	1 5/8	.052	3/16
3/16	.60	3 7/8	1 3/4	.104	1/4
1/4	.60	4	1 7/8	.156	5/16
5/16	.60	4 1/8	2	.208	3/8
3/8	.65	4 1/4	2 1/8	.260	7/16
7/16	.70	4 3/8	2 1/4	.313	1/2
1/2	.75	4 1/2	2 3/8	.365	9/16
9/16	.80	4 5/8	2 1/2	.417	5/8
5/8	.95	4 3/4	2 5/8	.469	11/16
11/16	1.10	4 7/8	2 3/4	.521	3/4
3/4	1.25	5	2 7/8	.573	13/16
13/16	1.50	5 1/8	3	.626	7/8
7/8	1.75	5 1/4	3 1/8	.677	15/16
15/16	2.00	5 3/8	3 1/4	.730	1″
1″	2.25	5 1/2	3 3/8	.782	1 1/16

For sets of Bit Stock Taper Reamers see page 264.

Morse Taper Reamers

WITH TAPER SQUARE SHANKS

FITTING RATCHETS



Used by Street Railways in Bonding Work.

CARBON STEEL No. 836

No. of Taper	Price Each	Whole Length Inches	Length of Flutes Inches	Diameter of Flutes		Size of Shank Inches
				Large End	Small End	
3	$3.40	6¾	4¼	.988	.775	½ x ¾ x 1¾

Center Reamers

FLUTED TYPE

The included angle is 60° unless otherwise specified.

Center Reamers with 82° included angle will be furnished at regular prices.

CARBON STEEL No. 837 **HIGH SPEED STEEL No. 1037**

Size Cut Inches	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Diameter Shank Inches	Length Shank Inches
¼	$0.40	$1.00	1½	3/16	¾
⅜	.45	1.15	1¾	¼	⅞
½	.55	1.40	2	⅜	1
⅝	.70	1.75	2¼	⅜	1
¾	.85	2.15	2⅝	½	1¼

Center Reamers—Flatted Type. Prices on application.

Bridge and Boiler Reamers

TAPER SHANK—STRAIGHT FLUTES

A B C

CARBON STEEL No. 871 **HIGH SPEED STEEL No. 971**

Diameter Inches at A and B	Diameter Inches at C	Price Each Carbon Steel	Price Each High Speed Steel	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
13/32	7/32	$ 2.60	$ 3.40	8 1/4	4 3/8	
7/16	1/4	2.60	3.40	8 1/4	4 3/8	
15/32	1/4	2.75	3.65	9	5 1/8	
1/2	9/32	2.75	3.65	9	5 1/8	No. 2
17/32	5/16	2.90	4.00	9	5 1/8	
9/16	11/32	2.90	4.00	9	5 1/8	
5/8	3/8	3.05	4.70	10	6 1/8	
11/16	25/64	3.20	5.50	11 3/4	7 1/8	
3/4	7/16	3.35	6.00	12	7 3/8	
13/16	1/2	3.50	6.50	12	7 3/8	
7/8	9/16	3.75	7.00	12	7 3/8	
15/16	5/8	4.00	7.75	12	7 3/8	No. 3
1″	11/16	4.25	8.50	12	7 3/8	
1 1/16	3/4	4.50	9.50	12	7 3/8	
1 1/8	13/16	4.75	10.50	12	7 3/8	
1 3/16	7/8	5.00	11.75	12	7 3/8	
1 1/4	15/16	5.50	14.00	13	7 3/8	
1 5/16	1″	6.00	15.50	13	7 3/8	
1 3/8	1 1/16	6.50	17.50	13	7 3/8	No. 4
1 7/16	1 1/8	7.00	19.50	13	7 3/8	
1 1/2	1 3/16	8.00	22.00	13	7 3/8	

32nd sizes not listed will be made to linear dimensions of the next largest size with diameters proportionate.

Prices on application.

For Sockets and Sleeves see pages 274–275.

Bridge and Boiler Reamers

TAPER SHANK—SPIRAL FLUTES

A B C

HIGH SPEED STEEL No. 974

Diameter Inches at A and B	Diameter Inches at C	Price Each	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
13/32	7/32	$ 3.40	8 1/4	4 3/8	No. 2
7/16	1/4	3.40	8 1/4	4 3/8	
15/32	1/4	3.65	9	5 1/8	
1/2	9/32	3.65	9	5 1/8	
17/32	5/16	4.00	9	5 1/8	
9/16	11/32	4.00	9	5 1/8	
5/8	3/8	4.70	10	6 1/8	
11/16	25/64	5.50	11 3/4	7 1/8	No. 3
3/4	7/16	6.00	12	7 3/8	
13/16	1/2	6.50	12	7 3/8	
7/8	9/16	7.00	12	7 3/8	
15/16	5/8	7.75	12	7 3/8	
1″	11/16	8.50	12	7 3/8	
1 1/16	3/4	9.50	12	7 3/8	
1 1/8	13/16	10.50	12	7 3/8	
1 3/16	7/8	11.75	12	7 3/8	
1 1/4	15/16	14.00	13	7 3/8	No. 4
1 5/16	1″	15.50	13	7 3/8	
1 3/8	1 1/16	17.50	13	7 3/8	
1 7/16	1 1/8	19.50	13	7 3/8	
1 1/2	1 3/16	22.00	13	7 3/8	

32nd sizes not listed will be made to linear dimensions of the next largest size with diameters proportionate.

Prices on application.

For Sockets and Sleeves see pages 274–275.

Bridge and Boiler Reamers

SHORT SET

TAPER SHANK

A B C

SPIRAL FLUTE, HIGH SPEED STEEL No. 975

STRAIGHT FLUTE, HIGH SPEED STEEL No. 976

Diameter Inches at A and B	Diameter Inches at C	Price Each Straight and Spiral Flute	Whole Length Inches	Length of Flutes Inches	Morse Taper Shank
1/4	1/8	$ 2.55	5 7/16	2 1/2	No. 1
9/32	5/32	2.55	5 7/16	2 1/2	
5/16	11/64	2.70	5 11/16	2 3/4	
11/32	13/64	2.80	5 11/16	2 3/4	
3/8	15/64	2.80	5 11/16	2 3/4	
13/32	17/64	3.00	6 3/16	2 3/4	No. 2
7/16	1/4	3.10	6 15/16	3 1/2	
15/32	9/32	3.35	7 1/16	3 1/2	
1/2	19/64	3.45	7 9/16	4	
17/32	1/4	3.65	7 9/16	4	
9/16	9/32	3.65	7 9/16	4	
5/8	5/16	4.00	8 1/16	4 1/2	
11/16	3/8	4.50	8 13/16	4 1/2	No. 3
3/4	13/32	5.00	9 1/2	5	
13/16	15/32	5.35	9 1/2	5	
7/8	17/32	5.70	9 1/2	5	
15/16	19/32	6.20	9 1/2	5	
1"	21/32	6.75	9 1/2	5	
1 1/16	23/32	7.50	9 1/2	5	
1 1/8	25/32	8.25	9 1/2	5	
1 3/16	27/32	9.25	9 1/2	5	
1 1/4	29/32	11.00	9 1/2	5	

32nd sizes not listed will be made to linear dimensions of the next largest size with diameters proportionate.

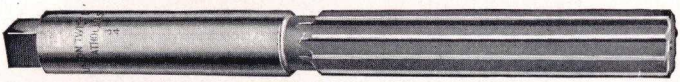
Prices on application.

For Sockets and Sleeves see pages 274–275.

Hand Reamers

STRAIGHT FLUTES

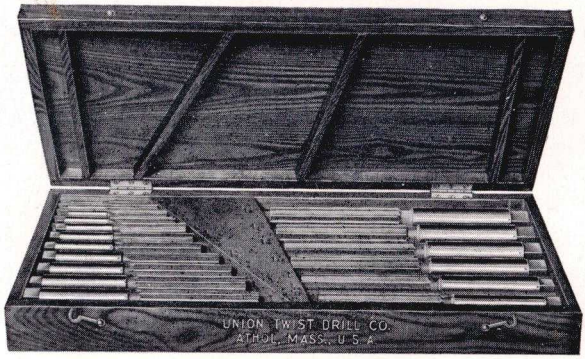
METRIC SIZES



CARBON STEEL No. 804

Diameter mm.	Price Each Carbon Steel	Decimal Equivalent	Whole Length mm.
3	$1.00	.1181	76
3½	1.20	.1378	79
4	1.20	.1575	82
4½	1.20	.1772	89
5	1.40	.1968	92
5½	1.40	.2165	95
6	1.40	.2362	102
6½	1.50	.2559	105
7	1.50	.2756	108
7½	1.50	.2953	112
8	1.60	.3150	117
8½	1.60	.3346	121
9	1.60	.3543	124
9½	1.60	.3740	127
10	1.75	.3937	133
10½	1.75	.4134	136
11	1.75	.4331	140
11½	1.90	.4528	143
12	1.90	.4724	149
13	2.00	.5118	155
14	2.00	.5512	165
15	2.20	.5905	171
16	2.40	.6299	182
17	2.40	.6693	190
18	2.60	.7087	206
19	2.60	.7480	213
20	2.80	.7874	226
21	3.10	.8268	233
22	3.10	.8661	246
23	3.40	.9055	256
24	3.70	.9449	267
25	3.70	.9842	274

Reamer Sets



CARBON STEEL

No. 25 Set Hand Reamers ¼″ to 1″ by 16ths in case complete, $38.50
No. 26 Set Hand Reamers ¼″ to 1¼″ by 16ths in case complete, 58.25
No. 27 Set Hand Reamers ¼″ to 1½″ by 16ths in case complete, 82.00
No. 28 Set Hand Reamers ¼″ to 2″ by 16ths in case complete, 154.00
No. 29 Set Hand Reamers ¼″ to 1″ by 32ds in case complete, 68.75
No. 34 Taper-Pin Reamers Nos. 0 to 10 inclusive in case complete, 28.50
No. 35 Morse Taper Finishing Reamers Straight Shank Nos. 1 to 5 inclusive in case complete, 25.00
No. 36 Bit Stock Taper Reamers ¼″ to ¾″ by 16ths in case complete, 8.50

No. 33

Taper-Pin Reamer Set

For use in Automobile Kit.

Nos. 0 to 5 inclusive.

Price complete with Box, $9.75

Arbors

SECTION INDEX

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Adapters—Collet—for National Standard Taper Spindle End 269

Arbors—Milling Machine Screw 269

Arbors—Shell Drill 270

Arbors—Shell Reamer 270

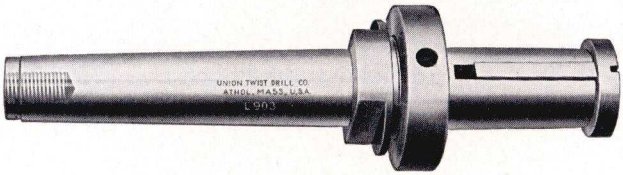
Mandrels—Lathe 271

Arbors for Face Milling Cutters

WITH INSERTED BLADES

Style A—Tang Drive

Style B—Tapped for Draw-in Bolt



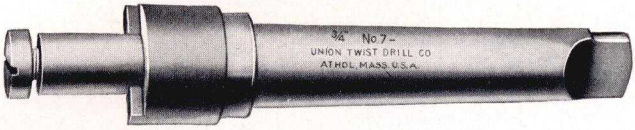
Style C—Clutch Drive Tapped for Draw-in Bolt
Style D—Similar to Style C, but no threaded hole

No.	No. of Taper of Shank	No. of Taper for Mill	Style	Price Each
L900	10	10	A	$14.00
L901	11	12	A	18.00
L902	11	12	B	18.00
L903	11	10	C	21.50
L904	11	12	C	21.50
L905	12	10	C	21.50
L906	12	12	C	21.50
L907	11	12	D	21.50
L908	12	12	D	21.50

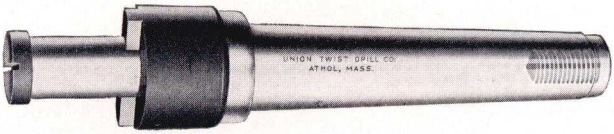
In ordering Style B or C specify size of tapped hole required in shank end; also form of thread and whether right or left hand thread.

For Face Milling Cutters see page 135.

Arbors for National Standard Shell End Mills



Style A—Tang Drive



Style B—Tapped for Draw-in Bolt

These Arbors fit National Standard Shell End Mills shown on page 45.
In ordering state whether arbor is for right or left hand mills.
In ordering Style B Arbors specify diameter and number of threads per inch, also whether right or left hand.

Catalog No.	No. of Taper	Diameter of Arbor Inches	Diameter of Mill Inches	Style	Price Each
NS 20	7	1/2	1 1/4, 1 1/2	A	$ 8.00
NS 21	9	1/2	1 1/4, 1 1/2	A	8.00
NS 22	9	1/2	1 1/4, 1 1/2	B	8.00
NS 23	9	3/4	1 3/4, 2	A	8.00
NS 24	9	3/4	1 3/4, 2	B	8.00
NS 25	10	3/4	1 3/4, 2	B	9.25
NS 26	9	1	2 1/4, 2 1/2, 2 3/4	A	8.25
NS 27	9	1	2 1/4, 2 1/2, 2 3/4	B	8.25
NS 28	10	1	2 1/4, 2 1/2, 2 3/4	B	9.75
NS 29	10	1 1/4	3, 3 1/2	A	10.50
NS 30	10	1 1/4	3, 3 1/2	B	10.50
NS 31	11	1 1/4	3, 3 1/2	B	15.00
NS 32	12	1 1/4	3, 3 1/2	B	17.00
NS 33	11	1 1/2	4, 4 1/2, 5	B	15.00
NS 34	12	1 1/2	4, 4 1/2, 5	B	17.00
NS 35	12	2	5 1/2, 6	B	20.00

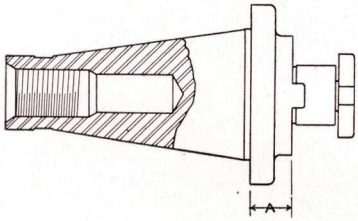
For National Standard Shell End Mills see page 45.

We can furnish Arbors for the Shell End Mills made before the adoption of the National Standard Shell End Mills.

Shell End Mill Arbors

FOR NATIONAL STANDARD TAPER SPINDLE END

Taper 3½ Inches per Foot



Style C

Chrome nickel heat treated screws for holding Shell End Mill on arbors are furnished with all arbors.

Wrenches are furnished with arbors 1¼″, 1½″ and 2″.

These Arbors can only be used on Machines having the New Standardized Spindle End.

In ordering specify diameter and number of threads per inch, also whether right or left hand.

Catalog No.	For Spindles with M.M. Std. Taper Hole No.	Dimension—Inches				Price Each
		Arbor Size		A	Diameters of National Standard Shell End Mills To Fit Arbors	
		Diameter	Length			
NS10	50	½	9/16	⅝	1¼, 1½	Prices on Application
NS11	50	¾	11/16	⅝	1¾, 2	
NS12	50	1	11/16	⅞	2¼, 2½, 2¾	
NS13	50	1¼	11/16	⅞	3, 3½	
NS14	50	1½	15/16	⅞	4, 4½, 5	
NS15	50	2	15/16	⅞	5½, 6	

For Collet Adapters see page 269.

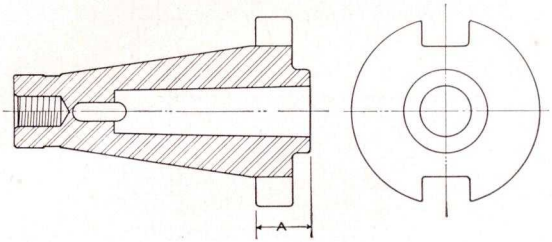
For Collets see page 276.

For Shell End Mills see pages 45, 140.

Collet Adapters

FOR NATIONAL STANDARD TAPER SPINDLE END

Taper 3½ Inches per Foot



Style E

These Adapters can only be used on Machines having the New Standardized Spindle End.

In ordering specify diameter and number of threads per inch, also whether right or left hand.

Catalog No.	For Spindles with M.M. Std. Taper Hole No.	Inside Taper	A Inches	Price Each
CA10	50	No. 9 B & S	1⅛	Prices on Application
CA11	50	No. 4 Morse	1⅛	

For Shell End Mill Arbors for National Standard Taper Spindle End see page 268.

For Collets see page 276.

Milling Machine Screw Arbors

FOR ANGLE MILLING CUTTERS WITH THREADED HOLES

In ordering, state whether right or left hand arbors are wanted.

Catalog No.	B & S. Taper Shank No.	For Cutters with Threaded Hole	Price Each
FA20	7	⅜″ 24 N. F.	$3.75
FA21	9	½″ 20 N. F.	5.00

For Angle Milling Cutters with Threaded Holes see page 53.

Shell Reamer Arbors

WITH STRAIGHT SHANKS

No. 404

No.	Price Each	Fitting Sizes Inches	Whole Length Inches	Length of Shank Inches	Diameter of Shank Inches
4	$2.70	21/32 to 25/32	9	6 5/32	1/2
5	3.00	13/16 to 1 1/32	9 1/2	6 11/32	5/8
6	3.30	1 1/16 to 1 9/32	10	6 15/32	3/4
7	3.60	1 5/16 to 1 21/32	11	7 5/32	7/8
8	4.00	1 11/16 to 2	12	7 17/32	1 1/8
9	4.50	2 1/16 to 2 1/2	13	8 9/32	1 3/8
10	5.25	2 9/16 to 3	14	8 29/32	1 5/8

These Arbors are designed to fit Shell Reamers and Shell Drills having taper holes 1/8 inch per foot.

For Shell Reamers see pages 244–245.

Shell Reamer Arbors

WITH MORSE TAPER SHANKS

No. 405

No.	Price Each	Fitting Sizes Inches	Whole Length Inches	Morse Taper Shank No.
4	$3.25	21/32 to 25/32	9	2
5	3.60	13/16 to 1 1/32	9 1/2	2
6	3.95	1 1/16 to 1 9/32	10	3
7	4.30	1 5/16 to 1 21/32	11	3
8	4.80	1 11/16 to 2	12	4
9	5.40	2 1/16 to 2 1/2	13	4
10	6.30	2 9/16 to 3	14	5

These Arbors are designed to fit Shell Reamers and Shell Drills having taper holes 1/8 inch per foot.

For Shell Reamers see pages 244–245.

Lathe Mandrels
Hardened and Ground Tool Steel

No. 401

These Mandrels are tapered .0005 to 1″.

The Mandrels from 1/8 to 1″ are .0005 below size at the small end, and those 1 1/16 to 3″ are .001 below size at the small end.

Diameter Inches	Whole Length Inches	Price Each	Diameter Inches	Whole Length Inches	Price Each
1/8	2 1/2	$1.20	1 3/16	7 3/4	$4.00
5/32	3	1.20	1 1/4	8	4.00
3/16	3	1.20	1 5/16	8 1/4	4.80
7/32	3 3/4	1.20	1 3/8	8 1/2	4.80
1/4	3 3/4	1.20	1 7/16	8 3/4	5.60
9/32	4	1.30	1 1/2	9	5.60
5/16	4	1.30	1 9/16	9 1/4	6.40
11/32	4 1/4	1.40	1 5/8	9 1/2	6.40
3/8	4 1/4	1.40	1 11/16	9 3/4	7.20
13/32	4 1/2	1.50	1 3/4	10	7.20
7/16	4 1/2	1.50	1 13/16	10 1/4	8.00
15/32	5	1.60	1 7/8	10 1/2	8.00
1/2	5	1.60	1 15/16	10 3/4	9.00
9/16	5 1/4	1.80	2	11	9.00
5/8	5 1/2	1.80	2 1/8	11 1/2	10.00
11/16	5 3/4	2.00	2 1/4	12	11.00
3/4	6	2.00	2 3/8	12	12.00
13/16	6 1/4	2.40	2 1/2	12 1/2	13.00
7/8	6 1/2	2.40	2 5/8	12 1/2	14.50
15/16	6 3/4	2.80	2 3/4	13	16.00
1	7	2.80	2 7/8	13	17.50
1 1/16	7 1/4	3.40	3	13	19.00
1 1/8	7 1/2	3.40			

UNION

"THE

TOOLS

YOU BUY

AGAIN"

Miscellaneous Tools

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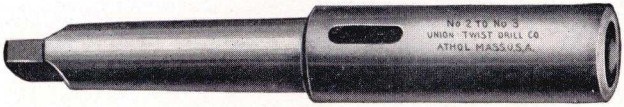
Steel Sockets

No. 400

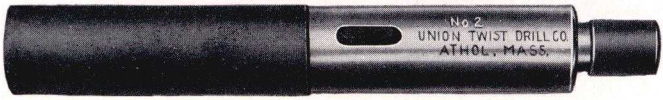


Morse Taper Inside	Morse Taper Shank	Price Each
No. 1	No. 2	$ 2.00
No. 1	No. 3	2.50
No. 1	No. 4	3.20
No. 1	No. 5	4.80
No. 2	No. 3	2.50
No. 2	No. 4	3.20
No. 2	No. 5	4.80
No. 3	No. 2	3.20
No. 3	No. 3	3.20
No. 3	No. 4	3.20
No. 3	No. 5	4.80
No. 4	No. 3	4.80
No. 4	No. 4	4.80
No. 4	No. 5	4.80
No. 4	No. 6	12.00
No. 5	No. 4	12.00
No. 5	No. 5	12.00
No. 5	No. 6	12.00

These Sockets can be furnished hardened and ground, inside and outside.
Prices quoted upon application.

Steel Sockets—Blank End

No. 410



No.	Morse Taper Inside	Whole Length Inches	Diameter of Blank End Inches	Length of Blank End Inches	Price Each
1	No. 1	7	1 1/8	3 7/8	$ 1.20
2	No. 2	8	1 1/4	4 1/4	1.80
3	No. 3	10	1 1/2	5 3/8	2.50
4	No. 4	13	2	7 3/8	4.00
5	No. 5	15	2 1/2	8	7.50
6	No. 6	18	3	8 3/4	14.00

Price includes plug for use in turning shank.
We are in a position to furnish Sockets for all oil-hole drills when required.

Steel Sleeves

No. 409

Morse Taper		Price Each	Morse Taper		Price Each
Inside	Outside		Inside	Outside	
No. 1	No. 2	$1.80	No. 2	No. 5	$ 4.40
No. 1	No. 3	2.40	No. 3	No. 4	3.00
No. 1	No. 4	3.00	No. 3	No. 5	4.40
No. 1	No. 5	4.40	No. 4	No. 5	4.40
No. 2	No. 3	2.40	No. 4	No. 6	10.00
No. 2	No. 4	3.00	No. 5	No. 6	10.00

These Sleeves can be furnished hardened and ground, inside and outside.
Prices quoted upon application.

Center Keys

No. 430

Steel drop forgings hardened and finished.

No.	Description	Price Each
1	Fitting No. 1 Socket or Sleeve	$0.30
2	Fitting No. 2 Socket or Sleeve	.35
3	Fitting No. 3 Socket or Sleeve	.40
4	Fitting No. 4 Socket or Sleeve	.50
5	Fitting No. 5 Socket or Sleeve	.60
6	Fitting No. 6 Socket or Sleeve	.75

Milling Machine Collets

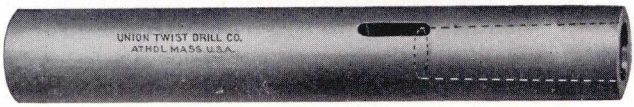
No. 420

No.	Brown & Sharpe Taper		Price Each
	Inside	Outside	
A	No. 4 B & S	No. 7 B & S	$2.75
N	No. 5 B & S	No. 7 B & S	2.75
C	No. 5 B & S	No. 9 B & S	3.75
B	No. 7 B & S	No. 9 B & S	4.50
EE	No. 5 B & S	No. 10 B & S	5.00
E	No. 7 B & S	No. 10 B & S	5.00
F	No. 9 B & S	No. 10 B & S	5.50
Q	No. 7 B & S	No. 11 B & S	6.00
G	No. 9 B & S	No. 11 B & S	6.50
P	No. 10 B & S	No. 11 B & S	8.75
*T	No. 9 B & S	No. 12 B & S	8.75
*PP	No. 10 B & S	No. 12 B & S	8.75

*Made with clutch drive and without tongue on end.

Collet Blanks

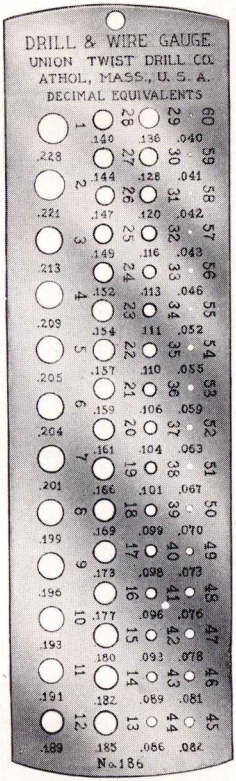
No. 425



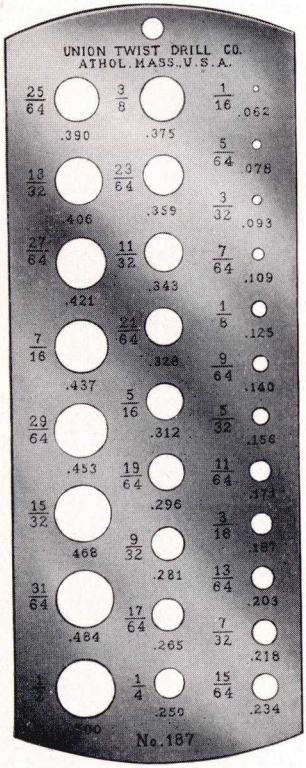
Diameter	Whole Length Inches	Brown & Sharpe Taper Inside	Price Each
3/4	5 1/4	No. 4 B & S	$2.25
1 1/8	8 1/2	No. 5 B & S	2.75
1 5/8	10	No. 7 B & S	3.25
1 5/8	12	No. 9 B & S	5.00
2	14	No. 10 B & S	6.00

Price includes plug for use in turning shank.

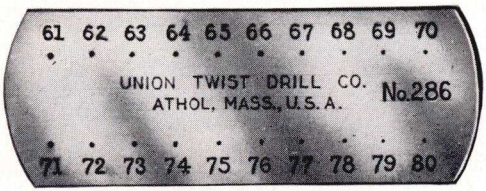
Drill Gauges



No. 186. Price, $2.00
Wire Gauge Sizes No. 1 to No. 60.

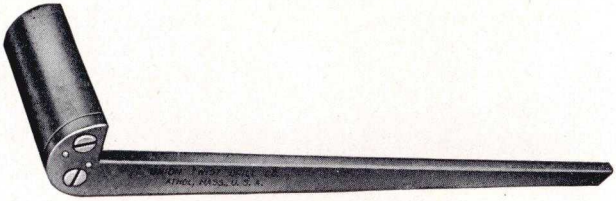


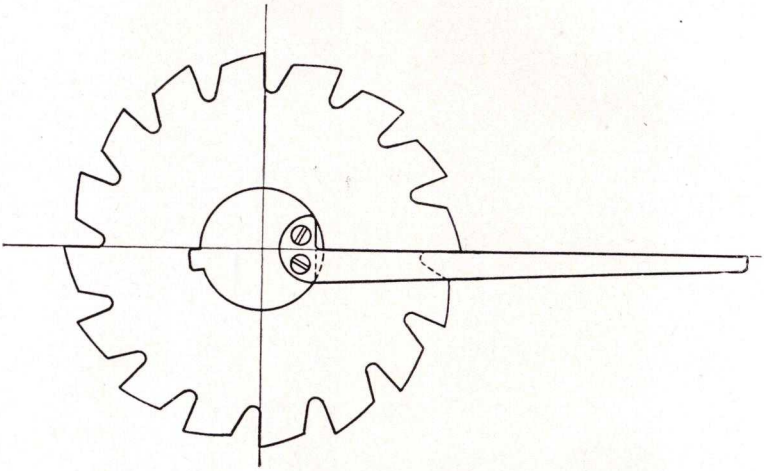
No. 187. Price, $2.75
Fractional Sizes 1/16″ to 1/2″



No. 286. Price, $2.40
Wire Gauge Sizes No. 61 to No. 80

Radial Grinding Gauge





For testing Gear and Formed Cutters radially when sharpening.
Price $6.75
This diagram illustrates the manner of using gauge.

Depth of Gear Tooth Gauges

All listed sizes 3 pitch to 48 pitch inclusive.....Price $0.60 each

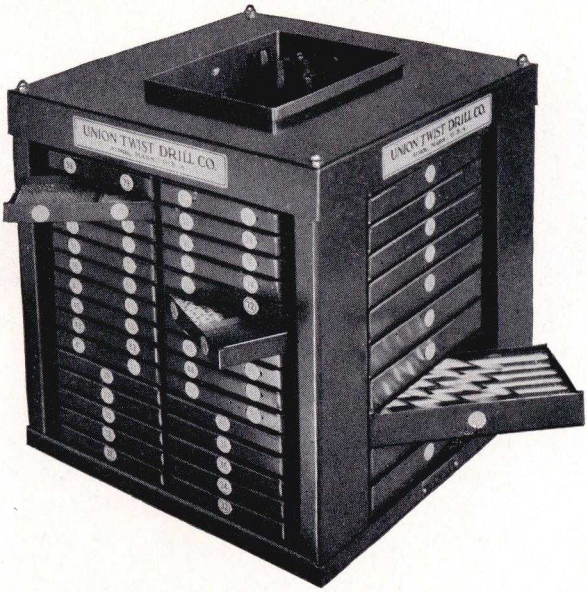
Depth of Gear Tooth Gauges for all regular pitches, from 3 to 48 pitch inclusive, are carried in stock. One gauge answers for each pitch, and indicates the extreme depth to be cut. Other sizes made to order.

Ideal Drill Case

THE ECONOMICAL WAY TO KEEP DRILLS

Rotates Easily—Every Drill Instantly Available—Drawers on Pivot—Cannot Be Dropped—Drawers Sealed When Shut.

KEEPS DRILLS CLEAN



Size 12″ x 12″ x 14″—Weight 38 lbs.—Shipping Weight 47 lbs.

A case that will take care of your Wire,
Jobbers' and Bit Stock Drills

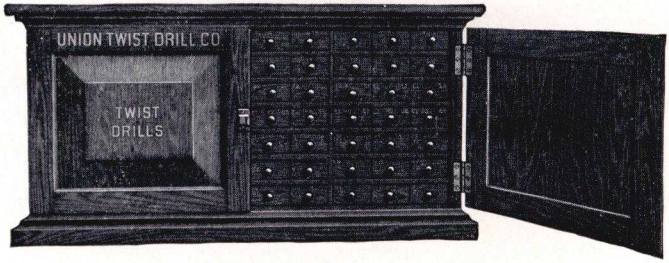
Two sides of the case have drawers for Wire Gauge Size Drills No. 1 to No. 80. On the other two sides are Jobbers' Drills $\frac{1}{32}$″ to $\frac{1}{2}$″ by 64ths. Bit Stock Drills may be kept in the top of the case. The size is shown by a metal plate attached to each drawer. (Cover for top section not shown in cut.)

Price, $22.00 f.o.b. Athol, Mass.

Drill Case

No. 1

OAK SIDES, FRONT AND TOP



$15\frac{3}{16}$ inches high
$29\frac{3}{16}$ inches wide
$10\frac{3}{8}$ inches deep

This case will hold drills as follows:

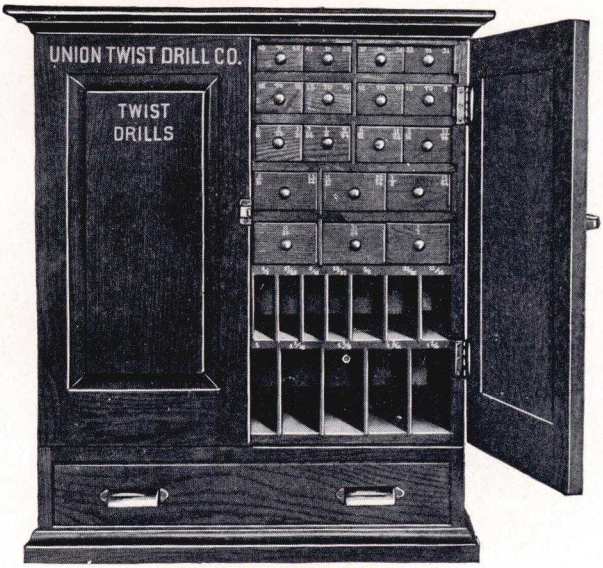
Wire Gauge Drills No. 1 to No. 80.
Jobbers' Drills $\frac{1}{16}$ to $\frac{1}{2}$ inch.

Price on application.

Drill Case

No. 2

OAK SIDES, FRONT AND TOP



29 inches high
24½ inches wide
15 inches deep

This case will hold drills as follows:

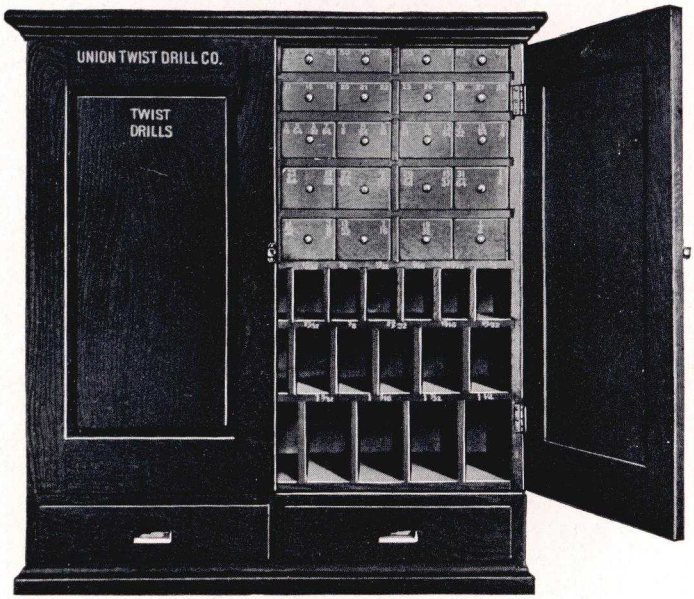
Wire Gauge Drills No. 1 to No. 65.
Jobbers' Drills 1/16 to ½ inch.
Taper Shank Drills ¼ to 1¼ inches.

Large drawer in bottom can be utilized for surplus stock, sockets, or other tools.

Price on application.

Drill Case No. 3

OAK SIDES, FRONT AND TOP



40 inches high
37½ inches wide
16⅞ inches deep

This case will hold drills as follows:

Wire Gauge Drills No. 1 to No. 65.
Jobbers' Drills 1/16 to ½ inch.
Bit Stock Drills 1/16 to ½ inch.
Taper Shank Drills ¼ to 1¼ inches.

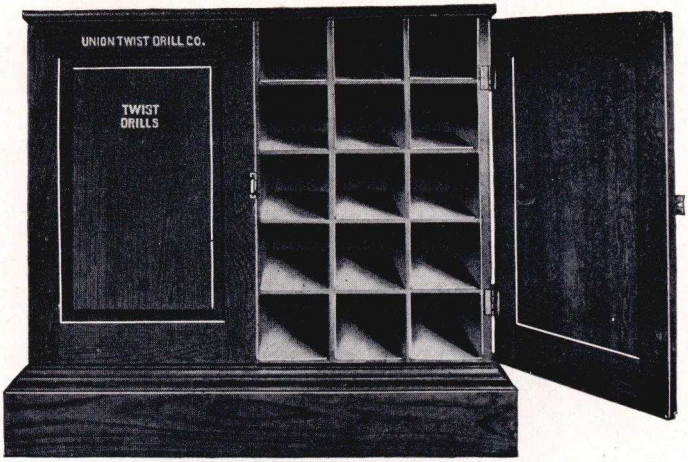
Two drawers in bottom can be utilized for surplus stock, sockets, or other tools

For No. 3 Drill Case Base see page 283.

Price on application.

Drill Case Base

OAK SIDES, FRONT AND TOP



37 inches high
41¾ inches wide
23⅞ inches deep

30 compartments 5⅜ inches high x 5⅝ inches wide.

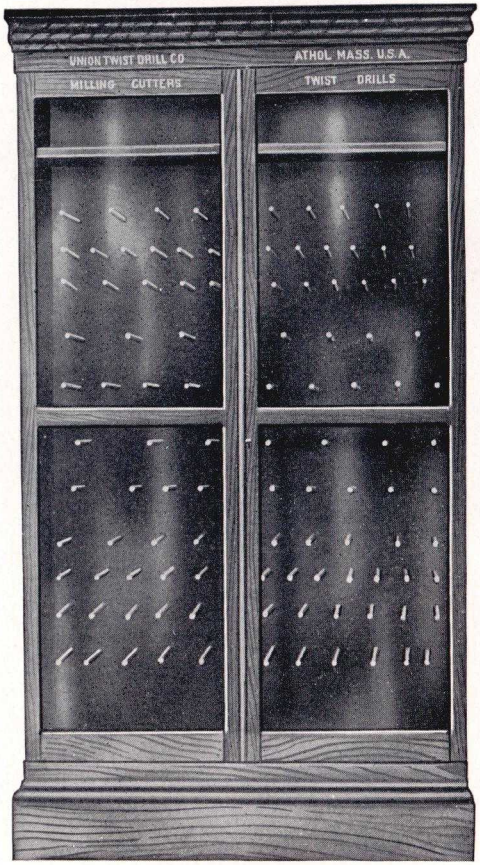
This case can be used as a base for No. 3 Drill Case when additional space is required.

See No. 3 Drill Case, page 282.

Price on application.

Cutter Case

OAK FRONT, SIDES AND TOP



5 feet, 11 inches high. 3 feet, 6 inches wide.
12 inches deep.

This case is arranged for holding an assorted stock of Angular Cutters, Gear Cutters, Metal Slitting Saws, Milling Cutters, Screw Slotting Cutters, and Side Milling Cutters.

Price on application.

Machine Tools

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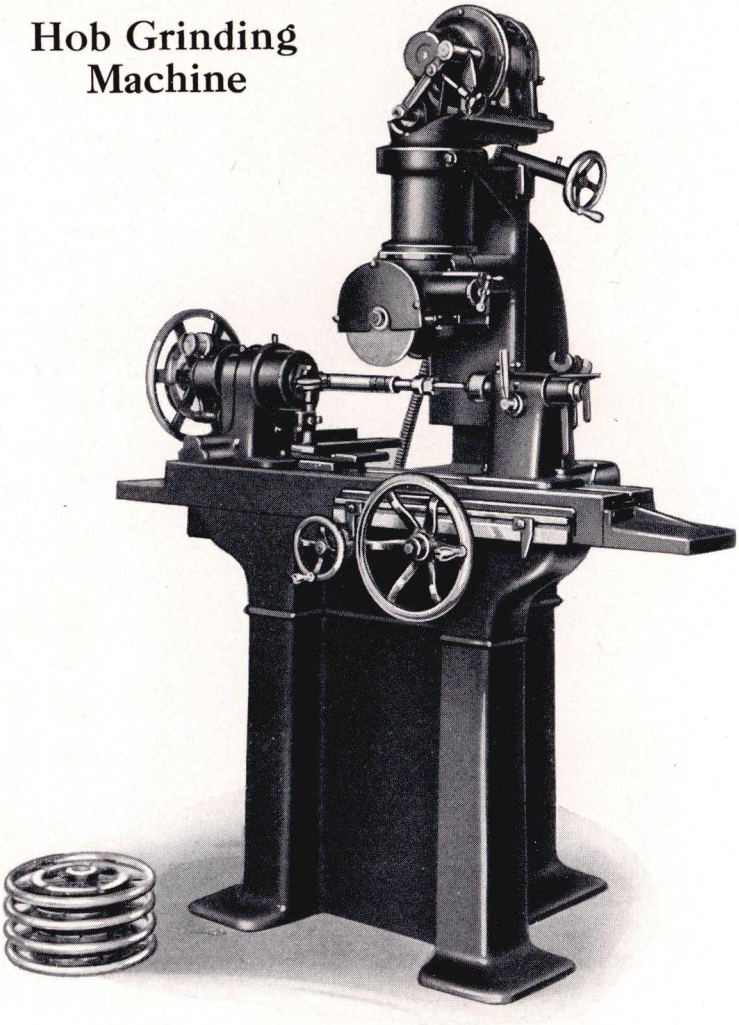
Combination Fixture for Testing Radius and Radial Face of Cutter Teeth 297

Hob Grinding Machine



For sharpening hobs having straight or spiral flutes of any pitch.
The above machine equipped for motor drive.
Motor 1 H.P., 1800 R.P.M. Pulley 3¾″ diameter, 1¾″ face.

Continued on page 287

Hob Grinding Machine—continued

This machine is designed for sharpening hobs. It has the capacity to take a hob up to 8″ in diameter and 12″ long. Hobs of any pitch and having either straight or spiral flutes may be ground.

The hob to be sharpened is mounted on an arbor which is carried by a center in the headstock spindle and supported at the outer end by the footstock center. Index plates for indexing any number of flutes from 5 to 14 are furnished with the machine.

The headstock spindle is geared to a rack bar which carries a roll engaging a slot in a swiveling bar at the back of the machine. This bar is similar to the taper attachment used on lathes. When the bar is set at an angle to the table, rotary motion is communicated to the headstock spindle. An adjusting screw permits of adjusting the degree of rotation to match the lead of spiral of the flutes in a hob.

The machine will grind either right or left hand spiral flutes and the grinding-wheel head may be swiveled to bring the wheel to the same angle as the flutes. A saucer-shaped or dished wheel 8″ diameter is used and the faces of the teeth of the hob are ground with the convex side of the wheel.

It will grind a lead as short as 8.62″, corresponding to a helix angle of 36° 5′ on a hob of 2″ pitch diameter.

A diamond truing device for truing the convex side of the wheel forms a part of the wheel guard.

The grinding wheel head may be adjusted vertically and horizontally to bring the wheel to the work and the cut is adjusted by rotating the hob on its axis through a worm wheel and worm.

The table is reciprocated by hand through a rack and pinion and hand wheel.

To insure that the hob will run true, it may be necessary to grind the faces of some of the flutes more than others.

To enable the high teeth of the hob to be indicated a testing fixture is provided. This is carried on the table and consists of slides supporting an indicating finger and a dial with a multiplying pointer which reads in thousandths of an inch.

Weight: Net 2,075 pounds. Boxed for shipment, 2,250 pounds.

Floor Space: 41½″ x 82″.

This machine is equipped for motor drive.

Price: Including motor, grinding wheel, one 1¼″ arbor, and necessary wrenches, on application.

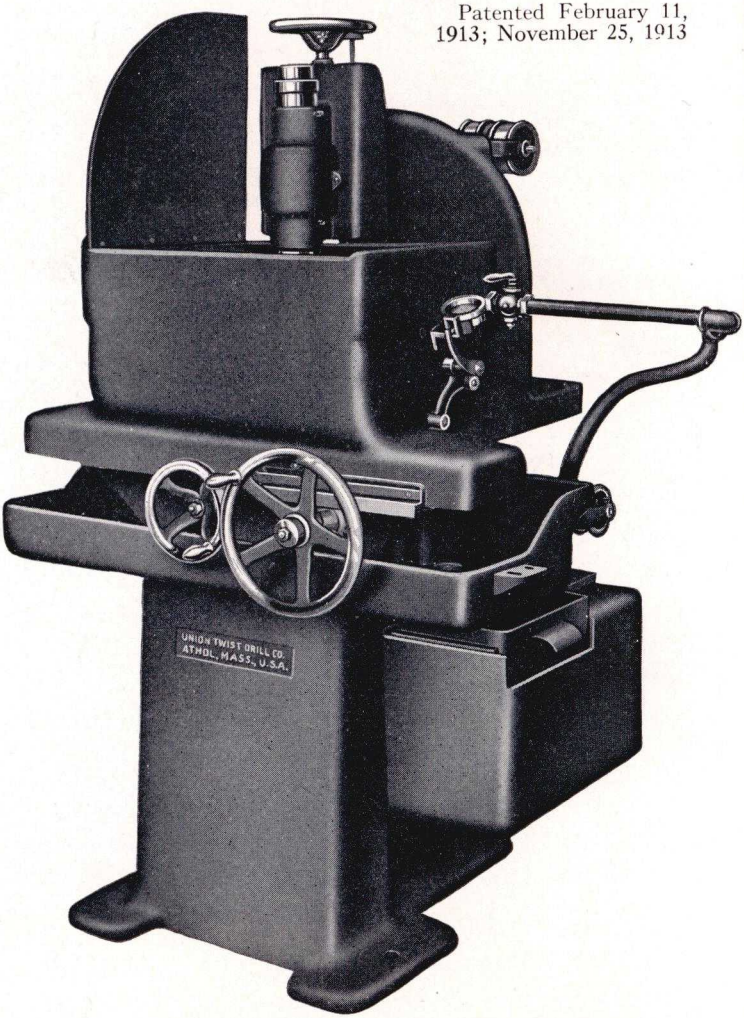
Motor: 1 H.P., 1,800 R.P.M.

Pulley: 3¾″ diameter, 1¾″ face.

Price on application.

No. 2 Formed Cutter Grinding Machine

Patented February 11, 1913; November 25, 1913



For grinding gear and other similar formed cutters to 8″ diameter and 3″ thick

Continued on page 289

No. 2 Formed Cutter Grinding Machine—continued

This machine will sharpen gear cutters and other similar formed cutters. By its use the cutting face of the teeth of a cutter may be ground radial or undercut and the periphery of each tooth the same distance from the center.

The cutters are indexed by a patented arrangement which consists of a gauge finger applied to the periphery of the tooth to be ground, the location of the finger being read on a dial with a multiplying pointer. The work slide is operated by a hand wheel through a rack and pinion.

Capacity: Will take cutters 8″ diameter and 3″ thick.

Spindle: Hardened, ground and lapped. Runs in bronze boxes provided with means of compensation for wear.

Grinding Wheel: 6″ diameter and has an adjustment of 4″ to or from the work arbor in a horizontal plane.

Wet Grinding: A pump and tank with suitable piping insures an ample flow of water to the grinding wheel.

Wheel Truing: A diamond located by use of a gauge in the horizontal plane passing through the work arbor serves to true the grinding wheel and also insures that the cutting face of the wheel shall be in the same horizontal plane.

Countershaft: Has tight and loose pulleys 6″ diameter for 2″ belt and should run 425 revolutions per minute.

Floor Space: 45″ x 38″.

Weight: Net, about 1,175 pounds. Boxed for shipment, about 1,500 pounds.

Equipment: Two work arbors and bushings for cutters with holes 1″, 1¼″, 1½″, 1¾″ and 2″. Grinding wheel, gauge for locating diamond, wrenches and countershaft.

Price on application.

No. 3 Circular Grinding Machine

MOTOR DRIVE

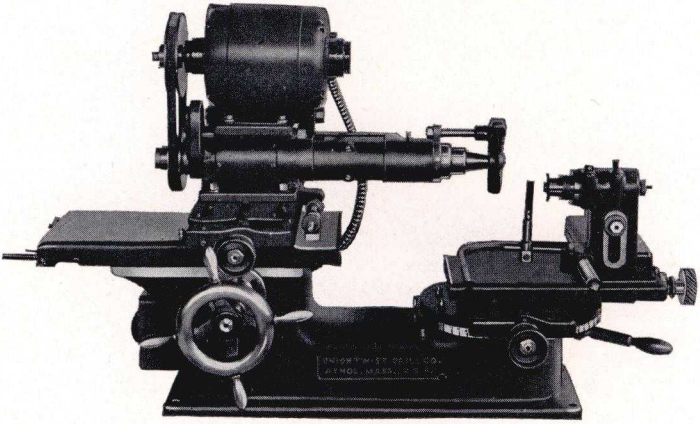


Fig. 1

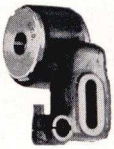


Fig. 2

Fig. 3

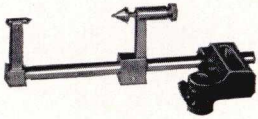


Fig. 4

Continued on page 291

No. 3 Circular Grinding Machine—continued

MOTOR DRIVE

Capacity: Will take cutters up to 10″ diameter. Arbors sent with machine provide for cutters not more than 2″ thick.

Convex Cutters: True half circles can be ground on cutters not less than about 4″ diameter. Arcs of circles of less than 180 degrees can be ground with a maximum radius of 2½″.

Concave Cutters: A part of a circle somewhat less than a half circle can be ground on a cutter not less than about 4″ diameter.

The peripheral teeth of end mills that are within the capacity of the machine can be ground as well as the teeth on Angular Cutters, Shank Rose Mills, and Cornering Cutters. The diameter of Shank Cutters that can be ground on this machine can be as large as 3″.

Equipment: Grinding wheel 4″ diameter x ½″ hole. Gauge for setting tooth rest. Work arbors for 1″, 1¼″, and 1½″ holes. Wrenches as shown in cut. Motor ⅓ h.p. 3600 syn. speed, ball bearing and totally enclosed. Wheel Spindle drive is from motor to spindle by single V Belt.

The wheel spindle is of steel, hardened and ground, running in 3 bronze bearings adjustable for wear. The spindle housing has rough adjustment to accommodate different size wheels and cutters. There is also a fine adjustment which is obtained by means of a knurled knob and screw which screw carries a graduated dial reading in thousandths.

The wheel can be traversed past the work by means of rack, pinion and hand wheel.

The work slides are mounted on a swivel plate to which is fastened a pivot stud which runs in a bronze bearing adjustable for wear. This swivel plate is graduated on edge 90 degrees each way of center. The slides carrying the work arbor holder are dovetail type with suitable gibs. These slides have fine adjustment by means of screw with graduated dial reading in thousandths.

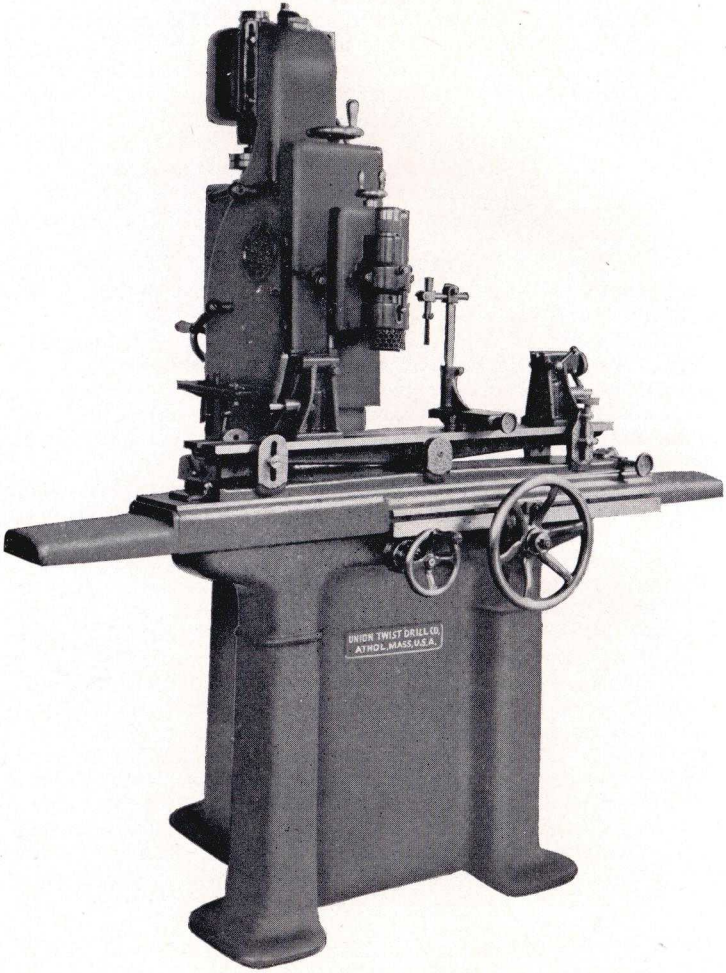
With this machine can be furnished, in addition to the regular work holding arbors, a fixture, Fig. (1) for holding straight shank cutters when held by shank when sharpening. A fixture, Fig. (2) for shank cutters with No. 9 B & S shank when held by shank for sharpening. By means of suitable reducing sleeves, shank cutters having a B & S or Morse smaller than No. 9 can also be handled in this machine. A fixture, Fig. (3) for shank cutters with No. 11 B & S shank when held by shank for sharpening. By means of suitable reducing sleeves, shank cutters having a B & S or Morse smaller than No. 11 can also be handled in this machine. A fixture, Fig. (4) for shank cutters that are held on centers.

Weight: Net, 385 pounds. Crated for shipment 438 pounds.

Price on application.

No. 1 Universal Cutter and Reamer Grinding Machine

WITH MOTOR DRIVE



Continued on page 293

No. 1 Universal Cutter and Reamer Grinding Machine

WITH MOTOR DRIVE

This machine is designed for sharpening straight or spiral milling cutters, face mills, end mills, and straight or taper reamers.

The machine will grind on centers a cutter 12″ in diameter or a reamer 24″ long.

The cup form of wheel used gives a flat clearance and a stronger cutting edge than that resulting from a disc wheel.

The spindle is of steel, hardened and ground, and runs in bronze boxes which are provided with means of adjustment for wear.

Machine is driven by a 1 H. P. 3600 R. P. M. Motor direct connected to rear drum shaft by flexible coupling.

Table is mounted on Roller Bearings and is reciprocated by Rack, Pinion, and Hand Wheel.

Weight of machine boxed for shipment about 1750 lbs. Net weight about 1500 lbs.

Floor space 35″ x 96½″.

Price on application.

For sharpening Face Mills, and side teeth of Side Mills a suitable fixture can be furnished, and also a fixture for sharpening the end teeth of End Mills.

For Face and Side Mill Grinding fixture see page 294. End Mill Grinding Fixture, see below.

End Mill Grinding Fixture

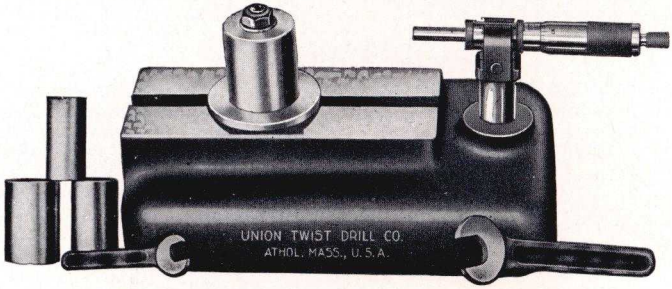
for use in connection with

NO. 1 UNIVERSAL CUTTER AND REAMER GRINDER

for sharpening the end teeth of End Mills

Price on application.

Micrometer Measuring Fixture



This fixture is of value in connection with the sharpening of gear and formed cutters.

By its use it can readily be determined if the teeth are equally distant from the center, as they should be, in order to do an equal amount of work.

Capacity: Cutters 10″ diameter x 3″ thick.

Bushings: Interchangeable, are provided for use with cutters having holes ⅝″, ¾″, 1″ and 1¼″ in diameter.

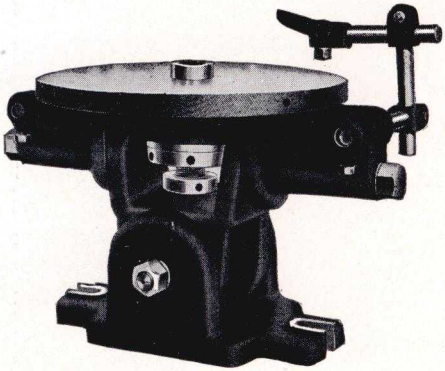
Price on application.

Face and Side Mill Grinding Fixture

for use in connection with

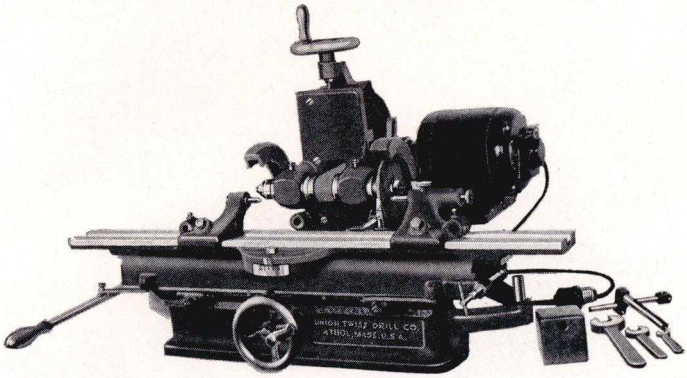
No. 1 UNIVERSAL CUTTER AND REAMER GRINDER

for sharpening Face Mills and side teeth of Side Mills, etc.



Price on application.

No. 1 Tool Grinding Machine



This machine is used for sharpening, on centers, straight or taper end mills, and reamers with either straight or spiral flutes.

Capacity: The machine takes 21 inches between centers with a maximum distance of 8 inches between wheel and center. It will grind cutters up to 3 inches in diameter.

Wheel Spindle: The wheel spindle is of steel, hardened and ground, and runs in bronze boxes adjustable for wear. Will take a wheel on either end.

Wheel Spindle Slide: Vertical adjustment ½ inch above or below center line of work.

Wheel Spindle Slide Upright: Traverse movement 2½ inches and is operated by a handwheel in front of machine.

The table runs on roller bearings and is graduated to swivel 10 degrees either way for tapered work. Can be swivelled 30 degrees either way where travel is short, to permit putting chamfers on corners. It is operated by a lever that is quickly transferred from one end of base to the other end for use in grinding both right and left-hand shank cutters. This machine takes a 4 by ¼ by ½ inch grinding wheel and same is driven by a motor of ⅓ H. P. 3600 R. P. M., 110 Volts, 60 Cycles, A. C.

Equipment: Motor and belt, diamond-holder, tooth rests for straight or spiral work, and necessary wrenches.

Weight Net 243 lbs. Boxed for Shipment 395 lbs.

Price on application.

Fixture for Testing the Radius and Radial Face of Cutter Teeth

This fixture is used in connection with the sharpening of gear and formed cutters.

By its use it can readily be determined if the teeth are equally distant from the center and if the face of teeth are radial.

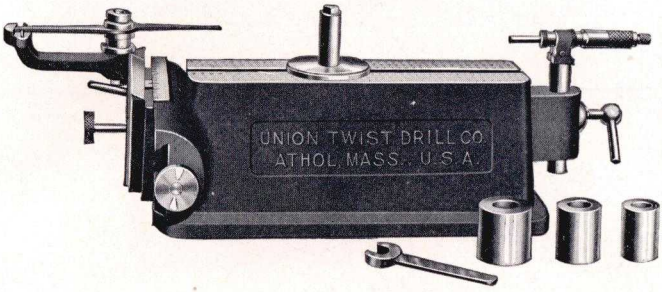
Capacity: Cutters 10″ diameter x 3″ thick.

Bushings: Interchangeable; for use with cutters having holes 1″, 1¼″ and 1½″ diameter.

Wrench is furnished also.

Price on application.

Combination Fixture for Testing Radius and Face of Cutter Teeth



This fixture is used in connection with the sharpening of gear and formed cutters having the face of teeth either radial or undercut.

By its use it can readily be determined if the teeth are equally distant from the center and if the face of teeth are radial or the proper amount back of center or undercut.

The face of the teeth are tested by means of finger mounted upon a slide. Readings can be taken from a scale mounted upon the body of fixture and graduated in 50ths.

The proper readings can be obtained by multiplying the radius of cutter by the following constants for the different angles of face:

Angle of Face	Constant
5°	.087
10°	.174
15°	.259
20°	.342
25°	.423

See Fig. 1.

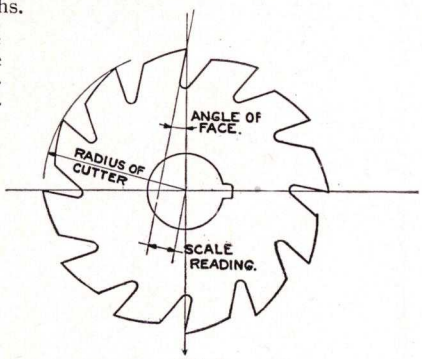


Fig. 1

For testing face of teeth for being radial bring slide to zero.

Capacity: Cutters 10″ diameter x 3″ thick.

Bushing: Interchangeable, for use with cutters having holes 1″, 1¼″ and 1½″ diameter.

Wrench is furnished also.

Price on application.

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General Information

SECTION INDEX

Pages

Hardness Conversion Table 300–301

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Decimal Equivalents of Twist Drill and Steel Wire Gauge 303

Decimal Equivalents of listed sizes 304–308

Weights of Round and Square Bars 309–310

Standard Tapers 311

Taper Shanks—B & S 312–314

Taper Shanks—Morse 315–316

Hardness Conversion Table

FOR STRUCTURAL ALLOY STEELS

(**Approximate**)

Rockwell				Rockwell			
C Scale 150 kg. 120° Diamond Cone	B Scale 100 kg. 1/16″ Ball	Brinell	Shore	C Scale 150 kg. 120° Diamond Cone	B Scale 100 kg. 1/16″ Ball	Brinell	Shore
68	...	780	96	32	...	311	43
67	...	745	94	31	...	302	42
65	...	712	92	30	...	293	41
63	...	682	89	29	...	285	40
62	...	653	86	28	...	277	38
60	...	627	84	27	...	269	37
58	...	601	81	26	...	262	36
56	...	578	78	25	...	255	35
55	...	555	75	24	100	248	34
53	...	534	73	23	99	241	33
51	...	514	71	22	99	235	32
50	...	495	68	21	98	229	32
48	...	477	66	20	97	223	31
47	...	461	64	18	96	217	30
46	...	444	62	17	95	212	30
44	...	429	60	16	95	207	29
43	...	415	58	14	93	197	28
42	...	401	56	12	91	187	27
41	...	388	54	10	89	179	25
39	...	375	52	8	87	170	24
38	...	363	51	6	85	163	23
37	...	352	49	4	83	156	23
36	...	341	48	2	81	149	22
35	...	331	46	0	79	143	21
34	...	321	45	−3	77	137	20

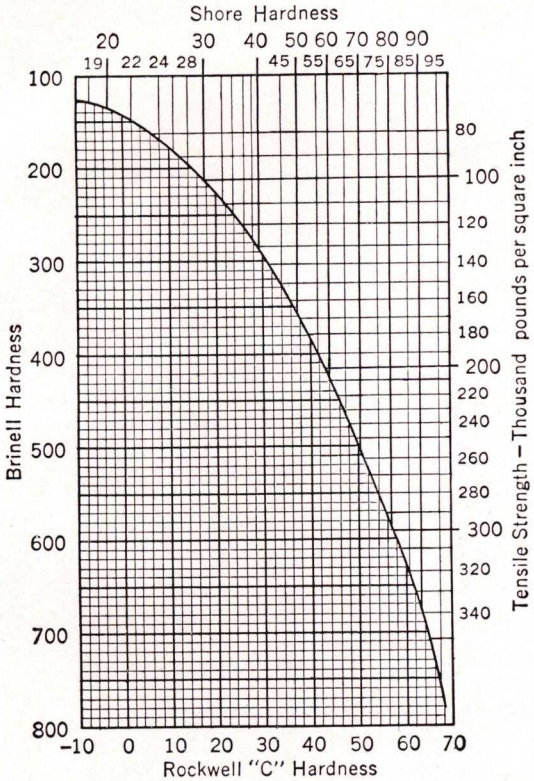
Data compiled by Research Lab., Development and Research Dept., The International Nickel Company, Inc., 67 Wall St., New York, N. Y.

Printed by courtesy of The International Nickel Company, Inc.

Continued on page 301

Hardness Conversion Table—continued

Approximate Relations between Brinell, Rockwell and Shore Hardnesses and the Tensile Strengths of Structural Alloy Steels



Conversions from one scale to another are made at the intercepts with the curve crossing the chart. For example, follow the horizontal line representing 200 Brinell hardness to its intersection with the conversion curve. From this point follow vertically upward for equivalent Shore hardness values (28), vertically downward for Rockwell C values (14+), and horizontally to the right for the tensile strength (96,000).

By courtesy of The International Nickel Company, Inc.

Table of Decimal Equivalents

Of 8ths, 16ths, 32ds, and 64ths of an inch

8ths.

$\frac{1}{8}$ = .125
$\frac{1}{4}$ = .250
$\frac{3}{8}$ = .375
$\frac{1}{2}$ = .500
$\frac{5}{8}$ = .625
$\frac{3}{4}$ = .750
$\frac{7}{8}$ = .875

16ths.

$\frac{1}{16}$ = .0625
$\frac{3}{16}$ = .1875
$\frac{5}{16}$ = .3125
$\frac{7}{16}$ = .4375
$\frac{9}{16}$ = .5625
$\frac{11}{16}$ = .6875
$\frac{13}{16}$ = .8125
$\frac{15}{16}$ = .9375

32ds.

$\frac{1}{32}$ = .03125
$\frac{3}{32}$ = .09375
$\frac{5}{32}$ = .15625
$\frac{7}{32}$ = .21875
$\frac{9}{32}$ = .28125
$\frac{11}{32}$ = .34375
$\frac{13}{32}$ = .40625
$\frac{15}{32}$ = .46875
$\frac{17}{32}$ = .53125
$\frac{19}{32}$ = .59375
$\frac{21}{32}$ = .65625
$\frac{23}{32}$ = .71875
$\frac{25}{32}$ = .78125
$\frac{27}{32}$ = .84375
$\frac{29}{32}$ = .90625
$\frac{31}{32}$ = .96875

64ths.

$\frac{1}{64}$ = .015625
$\frac{3}{64}$ = .046875
$\frac{5}{64}$ = .078125
$\frac{7}{64}$ = .109375
$\frac{9}{64}$ = .140625
$\frac{11}{64}$ = .171875
$\frac{13}{64}$ = .203125
$\frac{15}{64}$ = .234375
$\frac{17}{64}$ = .265625
$\frac{19}{64}$ = .296875
$\frac{21}{64}$ = .328125
$\frac{23}{64}$ = .359375
$\frac{25}{64}$ = .390625
$\frac{27}{64}$ = .421875
$\frac{29}{64}$ = .453125
$\frac{31}{64}$ = .484375
$\frac{33}{64}$ = .515625
$\frac{35}{64}$ = .546875
$\frac{37}{64}$ = .578125
$\frac{39}{64}$ = .609375
$\frac{41}{64}$ = .640625
$\frac{43}{64}$ = .671875
$\frac{45}{64}$ = .703125
$\frac{47}{64}$ = .734375
$\frac{49}{64}$ = .765625
$\frac{51}{64}$ = .796875
$\frac{53}{64}$ = .828125
$\frac{55}{64}$ = .859375
$\frac{57}{64}$ = .890625
$\frac{59}{64}$ = .921875
$\frac{61}{64}$ = .953125
$\frac{63}{64}$ = .984375

Table of Decimal Equivalents

OF THE

NUMBERS OF TWIST DRILL AND STEEL WIRE GAUGE

No.	Size of No. in Decimals	No.	Size of No. in Decimals	No.	Size of No. in Decimals	No.	Size of No. in Decimals
1	.2280	21	.1590	41	.0960	61	.0390
2	.2210	22	.1570	42	.0935	62	.0380
3	.2130	23	.1540	43	.0890	63	.0370
4	.2090	24	.1520	44	.0860	64	.0360
5	.2055	25	.1495	45	.0820	65	.0350
6	.2040	26	.1470	46	.0810	66	.0330
7	.2010	27	.1440	47	.0785	67	.0320
8	.1990	28	.1405	48	.0760	68	.0310
9	.1960	29	.1360	49	.0730	69	.02925
10	.1935	30	.1285	50	.0700	70	.0280
11	.1910	31	.1200	51	.0670	71	.0260
12	.1890	32	.1160	52	.0635	72	.0250
13	.1850	33	.1130	53	.0595	73	.0240
14	.1820	34	.1110	54	.0550	74	.0225
15	.1800	35	.1100	55	.0520	75	.0210
16	.1770	36	.1065	56	.0465	76	.0200
17	.1730	37	.1040	57	.0430	77	.0180
18	.1695	38	.1015	58	.0420	78	.0160
19	.1660	39	.0995	59	.0410	79	.0145
20	.1610	40	.0980	60	.0400	80	.0135

Decimal Equivalents of Listed Sizes

Decimal	In.	Wire	Mm.	Decimal	In.	Wire	Mm.	Decimal	In.	Wire	Mm.
.0135		80		.0380		62		.0730		49	
.0138			.35	.0390		61		.0748			1.9
.0145		79		.0394			1.	.0760		48	
.0156	1/64			.0400		60		.0768			1.95
.0157			.4	.0410		59		.0781	5/64		
.0160		78		.0413			1.05	.0785		47	
.0177			.45	.0420		58		.0787			2.
.0180		77		.0430		57		.0807			2.05
.0197			.5	.0433			1.1	.0810		46	
.0200		76		.0453			1.15	.0820		45	
.0210		75		.0465		56		.0827			2.1
.0217			.55	.0469	3/64			.0846			2.15
.0225		74		.0472			1.2	.0860		44	
.0236			.6	.0492			1.25	.0866			2.2
.0240		73		.0512			1.3	.0885			2.25
.0250		72		.0520		55		.0890		43	
.0256			.65	.0531			1.35	.0905			2.3
.0260		71		.0550		54		.0925			2.35
.0276			.7	.0551			1.4	.0935		42	
.0280		70		.0571			1.45	.0937	3/32		
.0293		69		.0590			1.5	.0945			2.4
.0295			.75	.0595		53		.0960		41	
.0310		68		.0610			1.55	.0965			2.45
.0313	1/32			.0625	1/16			.0980		40	
.0315			.8	.0629			1.6	.0984			2.5
.0320		67		.0635		52		.0995		39	
.0330		66		.0650			1.65	.1015		38	
.0335			.85	.0669			1.7	.1024			2.6
.0350		65		.0670		51		.1040		37	
.0354			.9	.0689			1.75	.1063			2.7
.0360		64		.0700		50		.1065		36	
.0370		63		.0709			1.8	.1083			2.75
.0374			.95	.0728			1.85	.1093	7/64		

Continued on page 305

Decimal Equivalents of Listed Sizes—cont'd

Decimal	In.	Wire	Mm.	Decimal	In.	Wire	Mm.	Decimal	In.	Wire	Mm.
.1100		35		.1610		20		.2090		4	
.1102			2.8	.1614			4.1	.2126			5.4
.1110		34		.1654			4.2	.2130		3	
.1130		33		.1660		19		.2165			5.5
.1142			2.9	.1673			4.25	.2187	7/32		
.1160		32		.1693			4.3	.2205			5.6
.1181			3.	.1695		18		.2210		2	
.1200		31		.1719	11/64			.2244			5.7
.1220			3.1	.1730		17		.2264			5.75
.1250	1/8			.1732			4.4	.2280		1	
.1260			3.2	.1770		16		.2283			5.8
.1280			3.25	.1772			4.5	.2323			5.9
.1285		30		.1800		15				Letter	
.1299			3.3	.1811			4.6	.2340		A	
.1338			3.4	.1820		14		.2344	15/64		
.1360		29		.1850		13	4.7	.2362			6.
.1378			3.5	.1870			4.75	.2380		B	
.1405		28		.1875	3/16			.2401			6.1
.1406	9/64			.1890		12	4.8	.2420		C	
.1417			3.6	.1910		11		.2441			6.2
.1440		27		.1929			4.9	.2460		D	6.25
.1456			3.7	.1935		10		.2480			6.3
.1470		26		.1960		9		.2500	1/4	E	
.1476			3.75	.1969			5.	.2520			6.4
.1495		25		.1990		8		.2559			6.5
.1496			3.8	.2008			5.1	.2570		F	
.1520		24		.2010		7		.2598			6.6
.1535			3.9	.2031	13/64			.2610		G	
.1540		23		.2040		6		.2638			6.7
.1562	5/32			.2047			5.2	.2656	17/64		
.1570		22		.2055		5		.2658			6.75
.1575			4.	.2067			5.25	.2660		H	
.1590		21		.2087			5.3	.2677			6.8

Continued on page 306

Decimal Equivalents of Listed Sizes—cont'd

Decimal	In.	Let.	Mm.	Decimal	In.	Let.	Mm.	Decimal	In.	Let.	Mm.
.2716			6.9	.3346			8.5	.4130		Z	
.2720		I		.3386			8.6	.4134			10.5
.2756			7.	.3390		R		.4219	27/64		
.2770		J		.3425			8.7	.4330			11.
.2795			7.1	.3437	11/32			.4375	7/16		
.2810		K		.3445			8.75	.4528			11.5
.2812	9/32			.3464			8.8	.4531	29/64		
.2835			7.2	.3480		S		.4687	15/32		
.2854			7.25	.3504			8.9	.4724			12.
.2874			7.3	.3543			9.	.4843	31/64		
.2900		L		.3580		T		.4921			12.5
.2913			7.4	.3583			9.1	.5000	1/2		
.2950		M		.3594	23/64			.5118			13.
.2953			7.5	.3622			9.2	.5156	33/64		
.2968	19/64			.3642			9.25	.5312	17/32		
.2992			7.6	.3661			9.3	.5315			13.5
.3020		N		.3680		U		.5469	35/64		
.3031			7.7	.3701			9.4	.5512			14.
.3051			7.75	.3740			9.5	.5625	9/16		
.3071			7.8	.3750	3/8			.5709			14.5
.3110			7.9	.3770		V		.5781	37/64		
.3125	5/16			.3780			9.6	.5906			15.
.3150			8.	.3819			9.7	.5937	19/32		
.3160		O		.3838			9.75	.6094	39/64		
.3189			8.1	.3858			9.8	.6102			15.5
.3228			8.2	.3860		W		.6250	5/8		
.3230		P		.3898			9.9	.6299			16.
.3248			8.25	.3906	25/64			.6406	41/64		
.3268			8.3	.3937			10.	.6496			16.5
.3281	21/64			.3970		X		.6562	21/32		
.3307			8.4	.4040		Y		.6693			17.
.3320		Q		.4062	13/32			.6719	43/64		

Continued on page 307

Decimal Equivalents of Listed Sizes—cont'd

Decimal	In.	Mm.	Decimal	In.	Mm.	Decimal	In.	Mm.
.6875	11/16		.9646		24.5	1.2402		31.5
.6890		17.5	.9687	31/32		1.2500	1 1/4	
.7031	45/64		.9842		25.	1.2598		32.
.7087		18.	.9844	63/64		1.2656	1 17/64	
.7187	23/32		1.0000	1		1.2795		32.5
.7283		18.5	1.0040		25.5	1.2812	1 9/32	
.7344	47/64		1.0156	1 1/64		1.2969	1 19/64	
.7480		19.	1.0236		26.	1.2992		33.
.7500	3/4		1.0312	1 1/32		1.3125	1 5/16	
.7656	49/64		1.0433		26.5	1.3189		33.5
.7677		19.5	1.0469	1 3/64		1.3281	1 21/64	
.7812	25/32		1.0625	1 1/16		1.3386		34.
.7874		20.	1.0630		27.	1.3437	1 11/32	
.7969	51/64		1.0781	1 5/64		1.3583		34.5
.8071		20.5	1.0827		27.5	1.3594	1 23/64	
.8125	13/16		1.0937	1 3/32		1.3750	1 3/8	
.8268		21.	1.1024		28.	1.3780		35.
.8281	53/64		1.1093	1 7/64		1.3906	1 25/64	
.8437	27/32		1.2220		28.5	1.3977		35.5
.8465		21.5	1.1250	1 1/8		1.4062	1 13/32	
.8594	55/64		1.1406	1 9/64		1.4173		36.
.8661		22.	1.1417		29.	1.4219	1 27/64	
.8750	7/8		1.1562	1 5/32		1.4370		36.5
.8858		22.5	1.1614		29.5	1.4375	1 7/16	
.8906	57/64		1.1719	1 11/64		1.4531	1 29/64	
.9055		23.	1.1811		30.	1.4567		37.
.9062	29/32		1.1875	1 3/16		1.4687	1 15/32	
.9219	59/64		1.2008		30.5	1.4764		37.5
.9252		23.5	1.2031	1 13/64		1.4844	1 31/64	
.9375	15/16		1.2187	1 7/32		1.4961		38.
.9449		24.	1.2205		31.	1.5000	1 1/2	
.9531	61/64		1.2344	1 15/64		1.5156	1 33/64	

Continued on page 308

Decimal Equivalents of Listed Sizes—cont'd

Decimal	In.	Mm.	Decimal	In.	Mm.	Decimal	In.	Mm.
1.5158		38.5	1.8437	1 27/32		2.4409		62.
1.5312	1 17/32		1.8504		47.	2.4803		63.
1.5354		39.	1.8750	1 7/8		2.5000	2 1/2	
1.5469	1 35/64		1.8898		48.	2.5197		64.
1.5551		39.5	1.9062	1 29/32		2.5590		65.
1.5625	1 9/16		1.9291		49.	2.5625	2 9/16	
1.5748		40.	1.9375	1 15/16		2.5984		66.
1.5781	1 37/64		1.9685		50.	2.6250	2 5/8	
1.5937	1 19/32		1.9687	1 31/32		2.6378		67.
1.5945		40.5	2.0000	2		2.6772		68.
1.6094	1 39/64		2.0079		51.	2.6875	2 11/16	
1.6142		41.	2.0313	2 1/32		2.7165		69.
1.6250	1 5/8		2.0472		52.	2.7500	2 3/4	
1.6339		41.5	2.0625	2 1/16		2.7559		70.
1.6406	1 41/64		2.0866		53.	2.7953		71.
1.6536		42.	2.0937	2 3/32		2.8125	2 13/16	
1.6562	1 21/32		2.1250	2 1/8		2.8346		72.
1.6719	1 43/64		2.1260		54.	2.8740		73.
1.6733		42.5	2.1562	2 5/32		2.8750	2 7/8	
1.6875	1 11/16		2.1653		55.	2.9134		74.
1.6929		43.	2.1875	2 3/16		2.9375	2 15/16	
1.7031	1 45/64		2.2047		56.	2.9527		75.
1.7126		43.5	2.2187	2 7/32		2.9921		76.
1.7187	1 23/32		2.2441		57.	3.0000	3	
1.7323		44.	2.2500	2 1/4		3.0625	3 1/16	
1.7344	1 47/64		2.2835		58.	3.1250	3 1/8	
1.7500	1 3/4		2.3125	2 5/16		3.1875	3 3/16	
1.7520		44.5	2.3228		59.	3.2500	3 1/4	
1.7717		45.	2.3622		60.	3.3125	3 5/16	
1.7812	1 25/32		2.3750	2 3/8		3.3750	3 3/8	
1.8110		46.	2.4016		61.	3.4375	3 7/16	
1.8125	1 13/16		2.4375	2 7/16		3.5000	3 1/2	

10 Mm. = 1 Centimetre = 0.3937 inches.
10 Cm. = 1 Decimetre = 3.937 inches.
10 Dm. = 1 Metre = 39.37 inches.
25.4Mm. = 1 English inch.

Weights

OF SQUARE AND ROUND BARS OF CARBON STEEL IN POUNDS PER LINEAR FOOT

Weight of 1 cubic inch = .285 lbs.

The following tables are calculated from the unit of 1 cubic inch = .3 lbs., which in practice has proved very accurate as nearly all steel is finished slightly full to dimensions.

Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long	Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long	Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long
1/16	.014	.011	1 9/16	8.78	6.90	3 1/16	33.7	26.5
1/8	.056	.044	1 5/8	9.50	7.46	3 1/8	35.1	27.6
3/16	.126	.099	1 11/16	10.24	8.05	3 3/16	36.5	28.7
1/4	.225	.177	1 3/4	11.02	8.65	3 1/4	38.0	29.8
5/16	.351	.276	1 13/16	11.82	9.28	3 5/16	39.5	31.0
3/8	.506	.397	1 7/8	12.65	9.94	3 3/8	41.0	32.2
7/16	.689	.541	1 15/16	13.51	10.61	3 7/16	42.5	33.4
1/2	.900	.707	2	14.4	11.3	3 1/2	44.1	34.6
9/16	1.13	.895	2 1/16	15.3	12.0	3 9/16	45.7	35.8
5/8	1.40	1.10	2 1/8	16.2	12.7	3 5/8	47.3	37.1
11/16	1.70	1.33	2 3/16	17.2	13.5	3 11/16	48.9	38.4
3/4	2.02	1.59	2 1/4	18.2	14.3	3 3/4	50.6	39.7
13/16	2.37	1.86	2 5/16	19.2	15.1	3 13/16	52.3	41.0
7/8	2.75	2.16	2 3/8	20.3	15.9	3 7/8	54.0	42.4
15/16	3.16	2.48	2 7/16	21.4	16.8	3 15/16	55.8	43.8
1	3.60	2.82	2 1/2	22.5	17.6	4	57.6	45.2
1 1/16	4.06	3.19	2 9/16	23.6	18.52	4 1/16	59.4	46.6
1 1/8	4.55	3.57	2 5/8	24.8	19.4	4 1/8	61.2	48.1
1 3/16	5.07	3.98	2 11/16	26.0	20.4	4 3/16	63.1	49.5
1 1/4	5.62	4.41	2 3/4	27.2	21.3	4 1/4	65.0	51.0
1 5/16	6.20	4.87	2 13/16	28.4	22.3	4 5/16	66.9	52.5
1 3/8	6.80	5.34	2 7/8	29.7	23.3	4 3/8	68.9	54.1
1 7/16	7.43	5.84	2 15/16	31.0	24.4	4 7/16	70.9	55.6
1 1/2	8.10	6.36	3	32.4	25.4	4 1/2	72.9	57.2

Continued on page 310

Weights—continued

OF SQUARE AND ROUND BARS OF CARBON STEEL IN POUNDS PER LINEAR FOOT

Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long	Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long	Thickness or Diam. in Inches	Weight of Square Bar One Foot Long	Weight of Round Bar One Foot Long
4 9/16	74.9	58.8	5 3/4	119.0	93.4	7 7/8	223.2	175.3
4 5/8	77.0	60.4	5 13/16	121.6	95.4	8	230.3	180.9
4 11/16	79.1	62.0	5 7/8	124.2	97.5	8 1/4	245.0	192.4
4 3/4	81.2	63.7	5 15/16	126.9	99.6	8 1/2	260.0	204.2
4 13/16	83.3	65.4	6	129.6	101.7	8 3/4	275.6	216.4
4 7/8	85.5	67.1	6 1/8	135.0	106.0	9	291.6	229.0
4 15/16	87.7	68.8	6 1/4	140.6	110.4	9 1/4	308.0	241.9
5	90.0	70.6	6 3/8	146.3	114.8	9 1/2	324.9	255.1
5 1/16	92.3	72.4	6 1/2	152.0	119.4	9 3/4	342.2	268.7
5 1/8	94.5	74.2	6 5/8	158.0	124.0	10	360.0	282.7
5 3/16	96.8	76.0	6 3/4	164.0	128.7	10 1/4	378.2	297.0
5 1/4	99.2	77.9	6 7/8	170.1	133.5	10 1/2	396.9	311.7
5 5/16	101.6	79.7	7	176.4	138.4	10 3/4	416.0	326.7
5 3/8	104.0	81.6	7 1/8	182.7	143.5	11	435.6	342.1
5 7/16	106.4	83.5	7 1/4	189.2	148.6	11 1/4	455.6	357.8
5 1/2	108.8	85.5	7 3/8	195.8	153.7	11 1/2	476.1	373.9
5 9/16	111.3	87.4	7 1/2	202.5	159.0	11 3/4	497.0	390.3
5 5/8	113.9	89.4	7 5/8	209.3	164.3	12	518.4	407.1
5 11/16	116.4	91.4	7 3/4	216.2	169.8			

In computing High Speed Steels the addition of 12½ per cent to the above weights for Carbon Steels will be a close approximation.

Standard Tapers

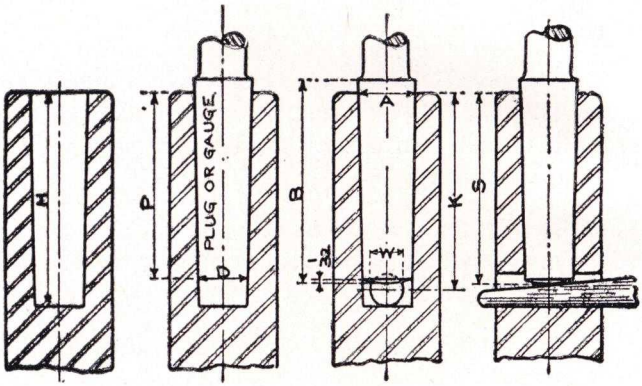
It is often the case that too little attention is given the matter of tapers. It is very important that the shanks of Cutters, Arbors, Drills, etc., should correspond in taper with the sockets or collets in which they are used, and be of the proper size to fit snugly.

The following tables will be helpful in selecting tapers and deciding questions which sometimes arise as to the sizes, amount of taper, etc.

As a rule, Milling Machine Spindles are made with holes of Brown & Sharpe Taper, while most Drill Presses, etc., are fitted with Morse Tapers.

B. & S. Taper Shanks

WITHOUT TONGUES

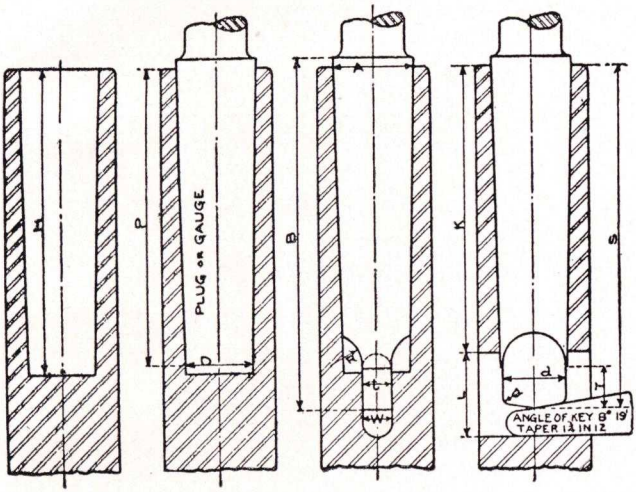


No. of Taper	Diam. of Plug at Small End	Diam. at End of Socket	Std. Plug Depth	Whole Length of Shank	Depth of Hole	End of Socket to Center of Key-way	Diam. of Key-way	Shank Depth	Taper per Foot	Taper per Inch
	D	A	P	B	H	K	W	S		
4	.35	.402	1 1/4	1 3/8	1 7/16	1 5/16	1/4	1 9/32	.50	.0416
5	.45	.5229	1 3/4	1 7/8	2	1 27/32	5/16	1 25/32	.50	.0416

Continued on page 313

B. & S. Taper Shanks—continued

WITH TONGUES



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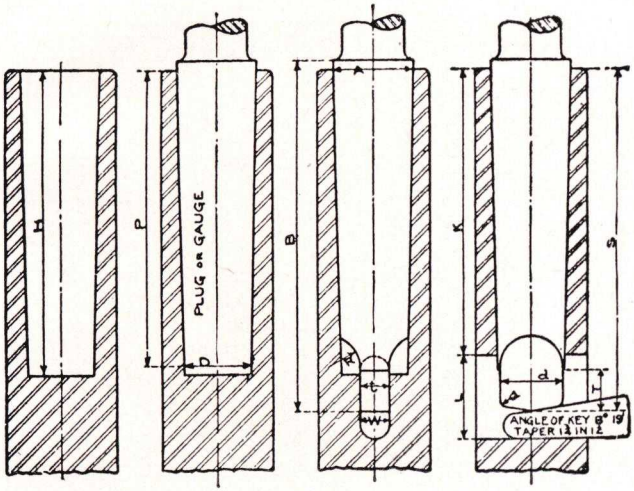
Brown and Sharpe Tapers—continued

No. of Taper	Diam. of Plug at Small End	Diam. at End of Socket	Std. Plug Depth	Whole Length of Shank	Depth of Hole	End of Socket to Key-way	Lgth. of Key-way	Width of Key-way	Lgth. of Ton-gue	Diam. of Ton-gue	Thick-ness of Ton-gue	Radius of Mill for Ton-gue	Radius of Ton-gue	Shank Depth	Taper per Foot	Taper per Inch
	D	A	P	B	H	K	L	W	T	d	t	R	a	S		
1	.200	.239	15/16	1 9/32	1 1/16	15/16	3/8	.135	3/16	.170	1/8	3/16	.030	1 3/16	.500	.0416
2	.250	.2995	1 3/16	1 19/32	1 5/16	1 1/64	1/2	.166	1/4	.220	5/32	3/16	.030	1 1/2	.500	.0416
3	.312	.3849	1 3/4	2 7/32	1 7/8	1 23/32	5/8	.197	5/16	.282	3/16	3/16	.040	2 1/8	.500	.0416
3	.312	.3954	2	2 15/32	2 1/8	1 31/32	5/8	.197	5/16	.282	3/16	3/16	.040	2 3/8	.500	.0416
4	.35	.402	1 1/4	1 3/4	1 3/8	1 13/64	11/16	.228	11/32	.320	7/32	5/16	.050	1 21/32	.500	.0416
5	.45	.5229	1 3/4	2 9/32	1 7/8	1 11/16	3/4	.260	3/8	.420	1/4	5/16	.060	2 3/16	.500	.0416
6	.50	.599	2 3/8	2 31/32	2 1/2	2 19/64	7/8	.291	7/16	.460	9/32	5/16	.060	2 7/8	.500	.0416
6	.50	.6354	3 1/4	3 27/32	3 3/8	3 11/64	7/8	.291	7/16	.460	9/32	5/16	.060	3 3/4	.500	.0416
7	.60	.725	3	3 5/8	3 1/8	2 29/32	15/16	.322	15/32	.560	5/16	3/8	.070	3 17/32	.500	.0416
7	.60	.7667	4	4 5/8	4 1/8	3 29/32	15/16	.322	15/32	.560	5/16	3/8	.070	4 17/32	.500	.0416
8	.75	.8985	3 9/16	4 1/4	3 11/16	3 29/64	1	.353	1/2	.710	11/32	3/8	.080	4 1/8	.500	.0416
9	.90	1.0667	4	4 3/4	4 1/8	3 7/8	1 1/8	.385	9/16	.860	3/8	7/16	.100	4 5/8	.500	.0416
10	1.0446	1.26	5	6 1/16	5 1/8	4 27/32	1 5/16	.447	21/32	1.01	7/16	1/2	.110	5 23/32	.5161	.043
10	1.0446	1.289	5 11/16	6 3/4	5 13/16	5 17/32	1 5/16	.447	21/32	1.01	7/16	1/2	.110	6 13/32	.5161	.043
10	1.0446	1.312	6 7/32	7 9/32	6 11/32	6 1/16	1 5/16	.447	21/32	1.01	7/16	1/2	.110	6 15/16	.5161	.043
11	1.25	1.53	6 3/4	7 13/16	6 7/8	6 19/32	1 5/16	.447	21/32	1.21	7/16	1/2	.130	7 15/32	.500	.0416
12	1.50	1.797	7 1/8	8 9/32	7 1/4	6 15/16	1 1/2	.510	3/4	1.46	1/2	1/2	.150	7 15/16	.500	.0416
13	1.75	2.073	7 3/4	8 11/16	7 7/8	7 9/16	1 1/2	.510	3/4	1.71	1/2	5/8	.170	8 9/16	.500	.0416
14	2.00	2.344	8 1/4	9 9/32	8 3/8	8 1/32	1 11/16	.572	27/32	1.96	9/16	3/4	.190	9 5/32	.500	.0416
15	2.25	2.615	8 3/4	9 25/32	8 7/8	8 17/32	1 11/16	.572	27/32	2.21	9/16	7/8	.210	9 21/32	.500	.0416
16	2.50	2.885	9 1/4	10 3/8	9 3/8	9	1 7/8	.635	15/16	2.45	5/8	1	.230	10 1/4	.500	.0416
17	2.75	3.156	9 3/4		9 7/8											
18	3.00	3.427	10 1/4		10 3/8											

Morse Taper Shanks



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Morse Taper Shanks—continued

No. of Taper	Diam. of Plug at Small End	Diam. at End of Socket	Shank		Depth of Hole	Standard Plug Depth	Tongue					Keyway		End of Socket to Keyway	Taper per Foot	Taper per Inch	No. of Key
			Whole Length of Shank	Shank Depth			Thickness of Tongue	Lgth. of Tongue	Rad. of Mill for Tongue	Diameter of Tongue	Radius of Tongue	Width of Keyway	Lgth. of Keyway				
	D	A	B	S	H	P	t	T	R	d	a	W	L	K			
0	.252	.3561	2 11/32	2 7/32	2 1/32	2	.1562	1/4	5/32	.235	.04	.160	9/16	1 15/16	.62460	.05205	0
1	.369	.475	2 9/16	2 7/16	2 3/16	2 1/8	.2031	3/8	3/16	.343	.05	.213	3/4	2 1/16	.59858	.04988	1
2	.572	.700	3 1/8	2 15/16	2 5/8	2 9/16	.250	7/16	1/4	17/32	.06	.260	7/8	2 1/2	.59941	.04995	2
3	.778	.938	3 7/8	3 11/16	3 1/4	3 3/16	.3125	9/16	9/32	23/32	.08	.322	1 3/16	3 1/16	.60235	.05019	3
4	1.020	1.231	4 7/8	4 5/8	4 1/8	4 1/16	.4687	5/8	5/16	31/32	.10	.478	1 1/4	3 7/8	.62326	.05193	4
5	1.475	1.748	6 1/8	5 7/8	5 1/4	5 3/16	.6250	3/4	3/8	1 13/32	.12	.635	1 1/2	4 15/16	.63151	.05262	5
6	2.116	2.494	8 9/16	8 1/4	7 3/8	7 1/4	.750	1 1/8	1/2	2	.15	.760	1 3/4	7	.62565	.05213	6
7	2.750	3.270	11 5/8	11 1/4	10 1/8	10	1.1250	1 3/8	3/4	2 5/8	.18	1.135	2 5/8	9 1/2	.62400	.05200	7

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